48120 October 1986 $2.50

# MODEL AIRPLANE NEWS

THE WORLD'S PREMIER R/C MODELING MAGAZINE

Canada $3.25


## The R/C Electric Revolution!

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OCTOBER 1986 VOLUME 113, NUMBER 4

# MODEL AIRPLANE NEWS

**ON THE COVER:** Definitely out of this world! That's what this beautiful photograph by ARCE Studios represents. Electrics are really "down to earth," however, and the Kyosho Duet is representative of the degree to which electrics have evolved. The Duet epitomizes the spirit of this issue—electric flight!

## FEATURES



### ELECTRIC KIT SUMMARY



## CONSTRUCTION



## COLUMNS



## COLUMNS



## DEPARTMENTS



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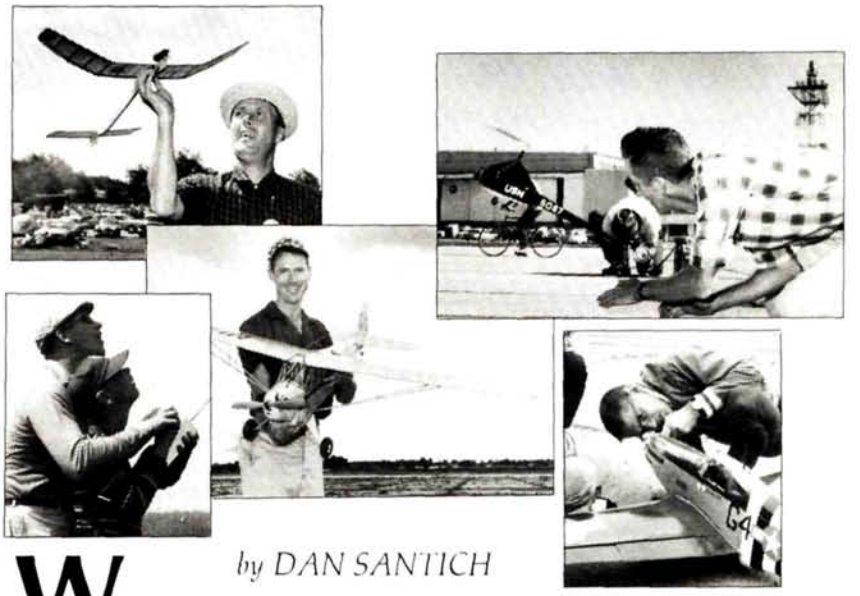
# Editorial



by DAN SANTICH

WE ARE ON YOUR SIDE. In fact, *Model Airplane News* has been on the side of the modeler for as long as I can remember. The words of past editors and authors shaped my perspective, inspired my creativity, and instilled in me a sense of pride in my accomplishments. Modeling, creativity, and *Model Airplane News* have one thing in common—you. You give us the drive to keep you inspired and we appreciate your presence, believe me. Much like the military service, modelers develop pride by association. You see the finest there is and you try your best to copy it.

When I was in the Air Force, Colonel Chuck Yeager passed through our base one day. When we were done servicing his plane he came out to pre-flight it. I asked him to sign the maintenance record for the work we had done. He looked at the entry in the book and then called the line chief over. He asked the sergeant something, then looked over at me and winked. After a little discussion, he signed the log, strapped himself in, and rode his thundering herd off into the blue.

When I got to my shop I called the line chief and asked him what the Colonel had said. "He just wanted to know if you were on our side," he replied.

I thought about that for a long time. Did he think I was a traitor or something? Quite the contrary. Yeager has so much pride in everything he does that it shines, and he felt that if I had pride in my work he could trust in the job I had done for him. That's what he meant by being on his side.

We are on your side.

Some of you have probably wondered why your favorite columnist does not appear in every issue. While we would love to run all our regular columns in every issue, space sometimes runs out. If a particular column is missing one month, look for it the following month. It will probably be there.

THIS MONTH. The electric revolution is upon us, yet many modelers know nothing about it. We have put together a variety of topics with a central theme so that you can get a handle on what electrics are all about. There is much more to electrics than we can possibly tell you about in one issue but we have covered most of the basics. Future issues will carry more on the subject, but for starters we hope this issue helps. DBS.

# Airwaves

### A Suggestion

I've been a reader of *Model Airplane News* for almost five years and I can no longer imagine the hobby without it. However, I am writing to voice an opinion, some praise, a complaint, and a suggestion.

I, like the average airplane modeler, read through your columns like "Giant Steps" and "Jet Blast" to dream of future projects that will probably never be realized. As a mere modeling "mortal," funds and time are limited. This restricts my modeling activities to Sunday flying of small sport ships and 2 meter gliders. Small steps, if you may.

The problem is that your magazine doesn't always cover the layman's aspect of the hobby. While columns like "First Steps" have come and gone, your construction articles of late have mostly been on 100-hour giant-scale ships or Turnaround pattern planes for the real stick wizards among us. Hear my plea—keep it simple.

My suggestion is a monthly column devoted to the small planes. Set a limit such as anything under 50-inch spans or .30 engines and begin with basic scuttlebutt, working your way up with reader-supplied information. You could find one of these small ship experts to be a columnist or (this would be my choice) have a different guest writer each month. They could ramble on about a flying day, theory, or a recent project. Give him any letters and pictures and let it take off from there.

I hope that I've been able to add some insight and a possibly helpful suggestion. I still look forward to each issue of *Model Airplane News.*

CRAIG HAMPSON
*Bridgewater, New Jersey*

*Good idea—any volunteers? DBS*

### Mystery Modeler Unmasked?

I believe the "mystery modeler" that Bob Saxon of Oklahoma is referring to in his letter to "Airwaves" (September 1986 *M.A.N.*) is Richard (Dick) Mathis of Snyder's Swamp Texas, not Schneider's Swamp, Virginia. I too admire his work and miss seeing his designs and writings.

CARL BEGELMAN
*Bayside, New York*

### "Pro & Con" Revisited

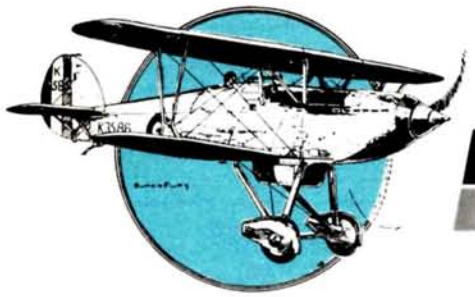
Budd Davisson's features are the first thing I turn to when I receive *Model Airplane News.* What a beautiful resource for scale modelers! Budd often refers to aeromodeling in his articles in an insightful way that adds depth to his writing. You should have him compare a good R/C model of the Christen Eagle—someone can help him fly it—to his latest story on the real one! Budd is a great source of the joys of aeromodeling and flying for personal, recreational, and historical purposes. *Model Airplane News,* Budd, and his fans are all to be congratulated. Recognition of the love of adventure and learning the art of flying—in what Paul Poberezny (I can't pass this up, coming from Wisconsin) refers to as "this ocean of air above us"—is wonderful!

BRAD SCOTT
*Shawano, Wisconsin*

I want to congratulate you on such a swell magazine. I particularly like your centerfolds, which I am framing. I think Budd Davisson is one of your best assets—his photos are terrific and I've yet to see him write a bad article.

Your magazine format is great. Like so many of your readers, I am an R/C sport-scale flier. Keep up the good work and thanks loads.

ROY ARSENAULT
*Methuen, Massachusetts*



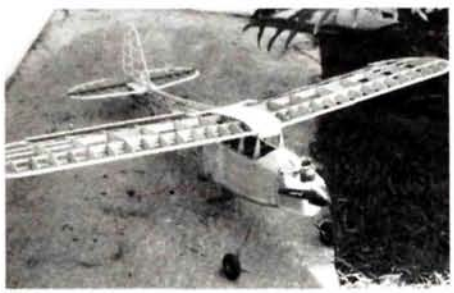
# Fifty Years Ago...

by DAN SANTICH


IN OCTOBER 1936, modeling in the U.S. was going through a big change. Where rubber- and $CO_2$-powered models had dominated the scene for years, gasoline engines and the airframes to carry them now seemed to be getting all the attention. Of course, the majority of modelers still used rubber-powered models, since the price of engines and gas model kits was out of reach for most. The average kit and engine combination cost around $30, and in 1936 that was more than a month's rent for the average family.

Construction methods in 1936 were the time-honored balsa stick and tissue, with dope for finishing. This was the lightest and strongest way known, although bamboo sticks were substituted for balsa where high strength was needed. The glue used to hold things together was slow in drying and usually took several hours to harden sufficiently before the parts could be moved. Kits sometimes included the covering material as well as the glue. Kit parts were not die-cut, but were printed on balsa sheets, requiring the modeler to cut out his own. This was a particularly difficult task since some of the parts were so small that it was nearly impossible to cut the notches on a bulkhead without splitting the balsa. With the coming of larger models for gas engines, this problem was eased somewhat.

**October 1936 witnessed PanAm's transpacific passenger service to Hawaii, Guam, and Manila. Photo courtesy of PanAm.**

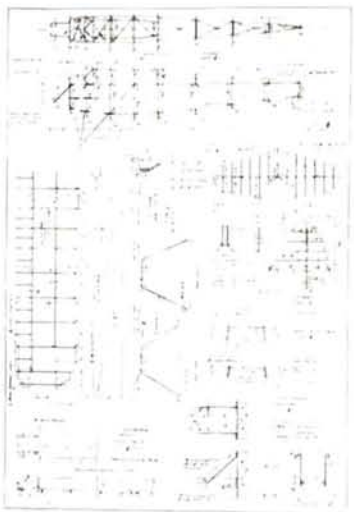


**The T-D Coupe was an extremely popular design by Theodore Dykzeul featured in October 1936 M.A.N. This T-D by Vic Wendt still flies.**

Commercial aviation was opening up lanes of travel all over the world, and Pan American World Airways established a new route from San Francisco Bay to Hawaii, Guam, and Manila with their famous China Clipper, ushering in a new glamour to the concept of air travel.

The military aviation scene in 1936 was in somewhat of a quagmire. Having been sold on the idea of faster and larger bombers, the Air Corps found itself with twin-engine bombers that were faster than the pursuit planes that were supposed to protect them. To deal with this problem, trials were held for Boeing, Martin, and Douglas to come up with a fighter that would have a top speed greater than the bombers' 250 mph at 10,000 feet performance record. At that time it was also of concern that the winner of the famed Thompson Trophy Race only managed 220 mph, and this with a so-called high-performance fighter-type aircraft. The military brass were also concerned that the high-performance capabilities of the new bombers placed the aircraft carrier in such a vulnerable position that it would be deemed useless. But that's the way it was in October 1936 and *Model Airplane News* was there to tell you about it. ■

**The Douglas DB-1 Bomber was an adaptation of the DC-2.**



**Plans for the T-D Coupe were very popular.**

RECEIVERS

# Basics of Radio Control

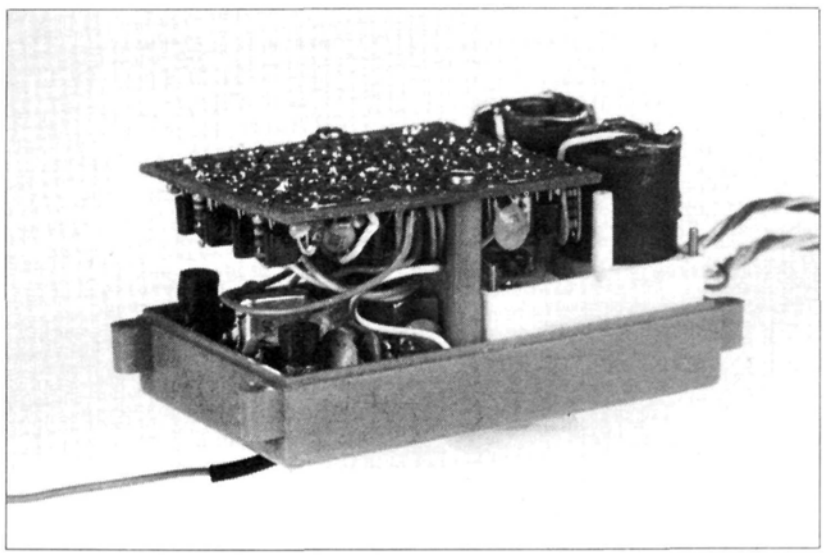
by RANDY RANDOLPH

LAST MONTH I talked about how servos work and referred to the receiver as the heart of the system. In a way, that's quite descriptive because the receiver pumps lifeblood, in the form of information, to the servos. Actually, the receiver itself doesn't tell the servos anything—the decoder takes care of that—but they are both in the same little box so I'll treat them as one.

The reception of radio signals is not at all complicated. If our transmitters were very powerful and the only source of radio signals in the world, we could fly our airplanes with receivers that contained only three things: an antenna, a small tightly-wound coil of wire (RF choke), and a diode. Now the decoder would still be a rather complicated device, but the receiver itself would be simple and very inexpensive! Unfortunately, our transmitters are not powerful and we are not alone in the world so the receiver requires more parts to do its job correctly, which is, of course, to hear only our signal.

In order for a receiver to hear only one signal at a time, it must be selective. Selectivity is acquired by substituting a tuned circuit in place of the RF choke in the receiver I just described. Unfortunately, one tuned circuit just won't be sharp enough, so another one is added. Because our transmitters are not powerful, we also need to add some amplification to our receiver. Even after adding lots of tuned circuits, it still isn't sharp enough.

Selectivity is a function of frequency. The higher the frequency, the broader the response of a tuned circuit, and we are operating on what is considered very high frequency in the 70- to 75-mh range. That "mh" stands for millions of cycles per second. Compare that with the standard AM broadcast band which is in thousands of cycles per second.

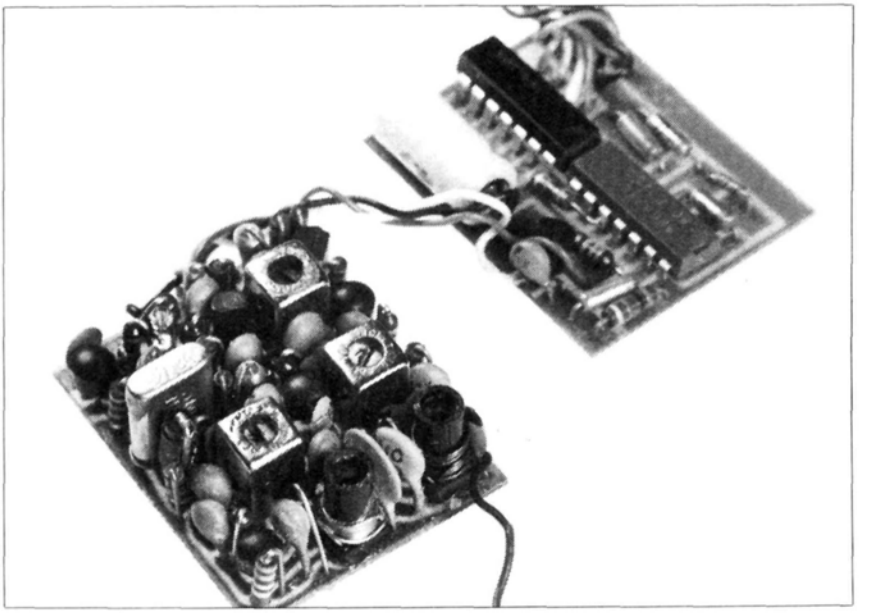


**Better known as a "brick," this airborne unit consists of receiver, decoder, and servos.**

If there were some way that the 75 mh signal could be brought down to a much lower frequency, our tuned circuits would work much better. There is a way and it's called heterodyning. To heterodyne a signal down in frequency, it is mixed with another signal and the difference between the two is then run through tuned circuits that bring about the selectivity we need. To bring about this magic, another signal is needed, usually about 450 kh (thousand cycles) above or below our received signal, and a thing called a "mixer."

A mixer is simply a device that accepts an external signal and one that is generated locally in the receiver. The mixer is followed by a circuit tuned to the difference frequency, about 450 kh. This new frequency is then amplified and sent to our diode detector. The crystal in our receivers is the thing that governs the frequency of this internal signal, called a local oscillator. The little square metal cans on the receiver board are the circuits that are tuned to the new 450 kh signal.

Because of the local oscillator, our receivers, as well as our transmitters, generate a radio frequency signal! If you happen to fly close to some fellow whose



**The modern receiver utilizes integrated circuits and will operate as many as eight servos.**

receiver is tuned to your receiver's crystal frequency (very unlikely), he will experience radio failure!

Another thing, since mixers are very similar to the first amplification stage in our receivers, it's quite possible that our neighbor's transmitted signal, on a different frequency, can mix with ours in the front end of our receiver (this happens), and then *we* experience radio failure! This type of mixing can occur in the first stage of various frequency-measuring instruments and give false readings that confuse even the experts operating the equipment. Heterodynes are a two-edged sword!

After our signal suffers through all the stages necessary to get to the detector, it still must go to the decoder. This nifty device counts the number, timing, and spacing of the pulses that our transmitter encodes on the signal, converts them to information the various servos can understand, and directs the information to the proper servo or servos. If the receiver is the heart, the decoder is the nervous system.

One thing that should be remembered: heat and cold can have an effect on the frequency of crystals. The passband, or the range of frequencies, passed by our receivers can't be too narrow or the frequency of the crystals can change enough to miss our receiver completely! Another thing worthy of consideration is that in the very high frequency ranges, narrow band FM transmission is *not* one of our most efficient methods of communication.

Next time I'll talk about transmitters and batteries.

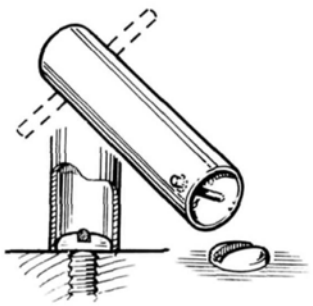
Incidentally, if you're a ham, I can be found on 14.185 mh ssb every Wednesday at 3:00 p.m. central time. My call is W5FEG. If you hear me, call and we'll talk model airplanes!

Randy Randolph, c/o *Model Airplane News,* 632 Danbury Rd., Wilton, CT 06897. ■

# Hints & Kinks

by JIM NEWMAN

**Model Airplane News** will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send rough sketch to Jim Newman, c/o **Model Airplane News**, 632 Danbury Rd., Wilton, CT 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO, AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we cannot acknowledge each one, nor can we return unused material.

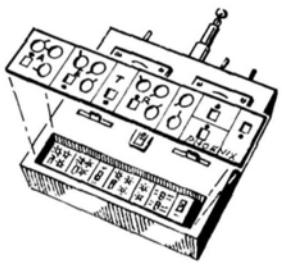


Ever had the screwdriver slip while attaching the wing? This wing bolt driver is designed **not** to slip. The tubing must be a snug fit over the head of the nylon bolt. Drill across the bottom end and solder in a piece of wire as shown. (The wire should be a snug fit in the screwdriver slot.) You can also solder a T-bar across the top for easier handling.

*Bill Mitch, Hebron, Indiana*

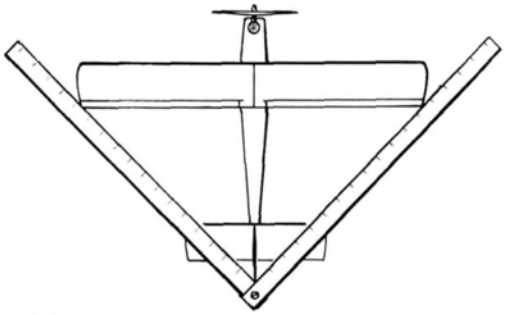
Some very neat axles, for use with sheet metal landing gears, can be made from a bright, 10-penny nail. Just cut to the desired length and thread the cut end with an 8-32 die. Lock two nuts together against the metal leg.

*Marshall Candies, Des Allemands, Louisiana*



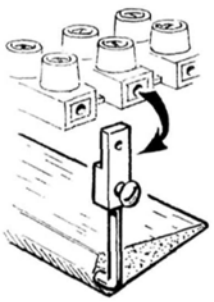
This flier has several models sharing a transmitter. To avoid the time-consuming chore of resetting the trimmers on the transmitter by trial and error, each time he changes models, he merely made a trimmer template after he had gotten each model/transmitter combination set up. The template drops over the trimmers and switches, and he then marks the settings on the template for future reference. **Be sure** to identify each template with the model name. (We Brits are so **terribly** formal.) Idea from:

*Mr. P. Startup, Oxford, England*



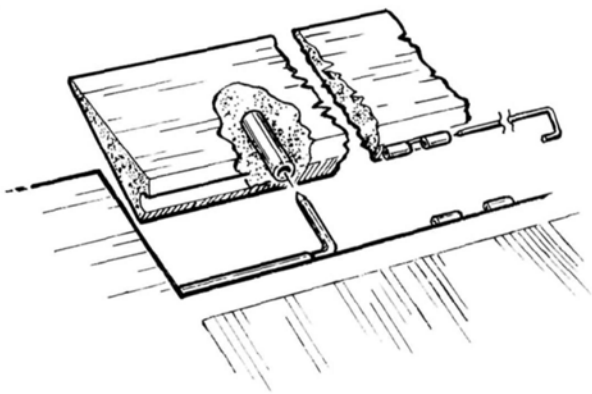
Two yardsticks with a pivot bolt at one end create a very convenient tool for checking the alignment of any model, using the trailing edge of the rudder or the tip of the engine shaft as a reference point.

*Chuck Lederer, Kansas City, Missouri*



You can make strip aileron horn connectors from electrical fittings. This metal piece is commonly found in those multiple terminal strips and, after removing, drill the end holes to suit, file one half to the desired thickness, then clamp or solder to the wire horn.

*Dan Tadmor, Tivon, Israel*



A problem with strip ailerons is that they have to be finished after attachment to the model—until now! This system allows them to be detached at any time. A metal tube bushing is glued into the root end of the aileron and the aileron horn then slips into this. The hinges are on a common long wire, inserted through the hinges from the wing tip where it is secured with a dab of glue or a sheet metal screw. Pull out the wire, then the ailerons can be slipped off the horn for repair or initial covering and painting.

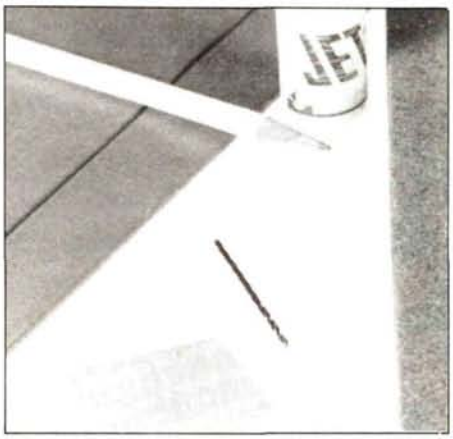
*Gene Chase, Oshkosh, Wisconsin*

# How To:

by RANDY RANDOLPH

## MAKE LIGHTWEIGHT PLYWOOD CONTROL HORNS

The use of plywood control horns goes way back to the early days of control-line flying. With proper installation, they are a very useful and lightweight method of controlling the surfaces of smaller R/C airplanes. The photos show the way.



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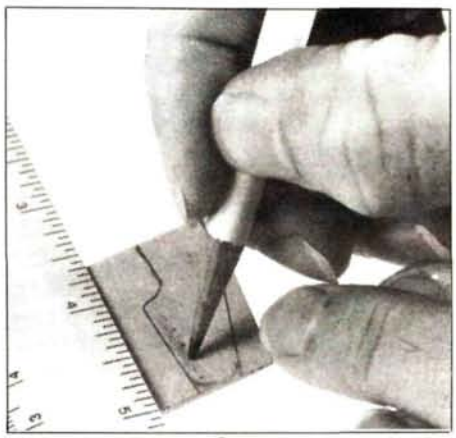
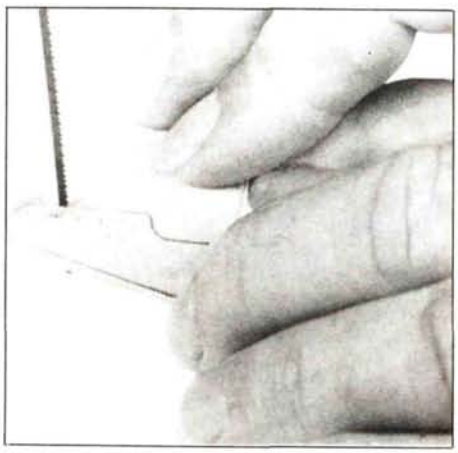


2.

1. The tool and material requirements are minimal: 1/16-inch aircraft plywood, a pencil or a pen, a sanding block, a 1/16-inch drill, and your trusty modeling knife.

2. Draw the horn outline on the 1/16-inch plywood. A standard plastic horn can be used as a model. The face grain of the ply should run the length of the horn.

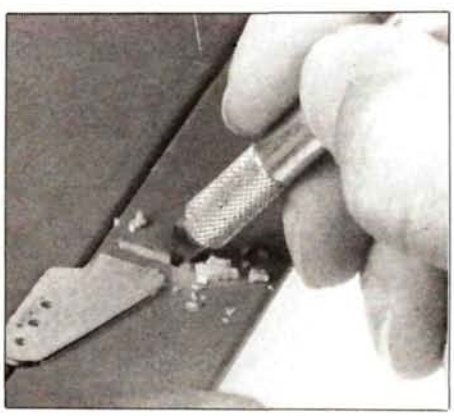


3.

3. Saw out the horn. Here is where the sanding block comes into play. Round the edges and smooth the sides of the nearly complete horn with 150-grit sandpaper.

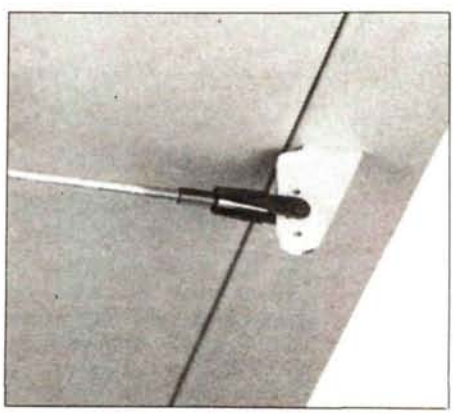
4.

4. Use a 1/16-inch drill and drill three or more holes as shown. The shape of the horn is such that the holes will line up with the hinge line of the control surface to which it is attached.



5.

5. Lay the horn on its side at the position it will occupy and cut a 1/16-inch wide notch, the length of the horn's base. Notice that the holes are lined up with the hinge line. The notch must go completely through the hinged surface.



6.

6. Glue the horn into the surface with one of the cyanoacrylate glues. If necessary, fill any voids with baking soda and apply more glue. Plywood control horns like these are not recommended for airplanes larger than .20 size.

*Construction*

by HAL "PAPPY" deBOLT


# SKEETER

## An electric twin with good looks and performance to match.

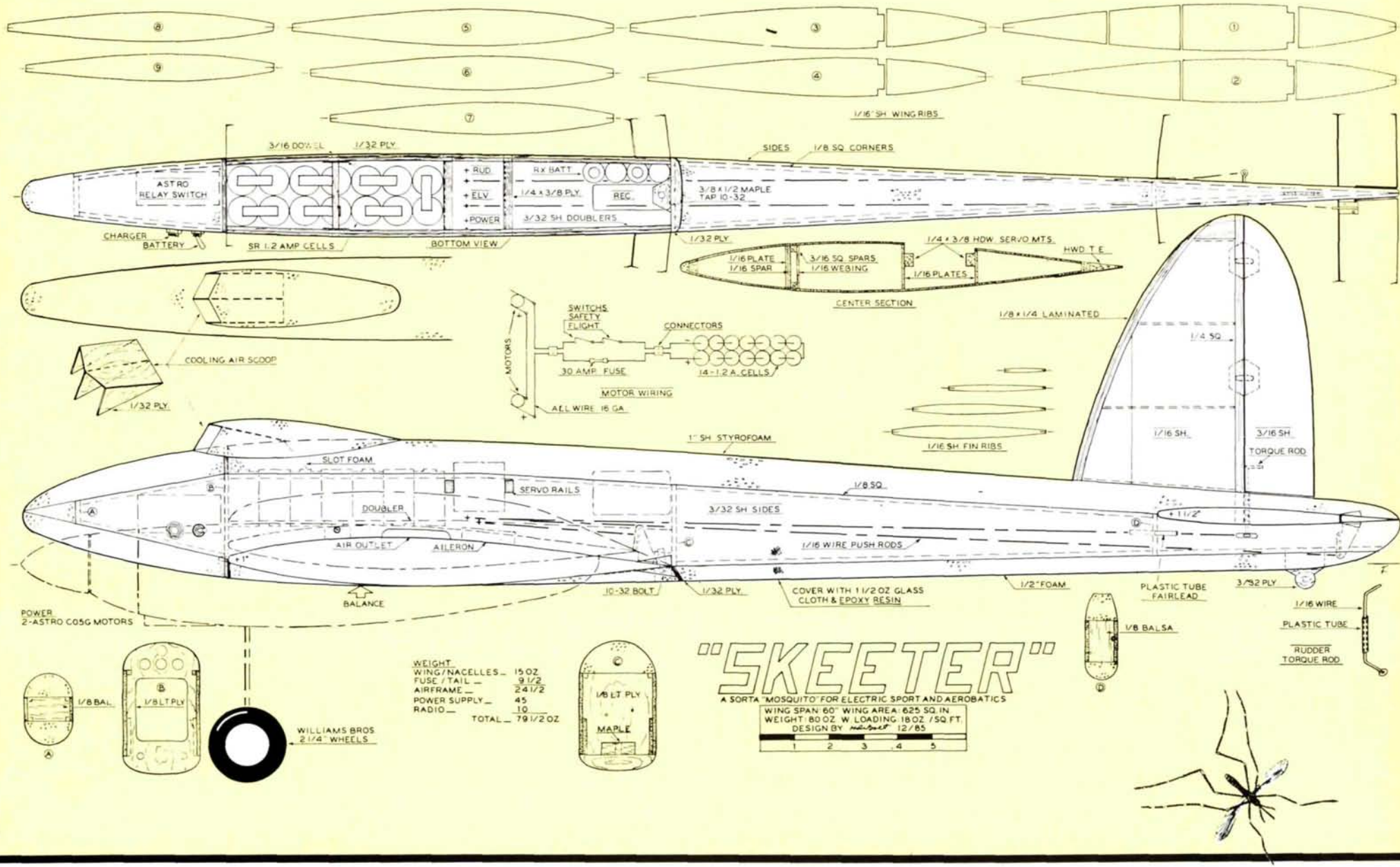
**WHEN** is a mosquito not a mosquito? When it's a cute little twin-engined mockup of the deHavilland Mosquito. Add electric power and you've got a "Skeeter."

I'm sure most modelers have dreamed of building a D.H. Mosquito, such a pretty airplane with its sleek lines and efficient shape. As a 400-mph full-scale aircraft built from model aircraft materials—balsa, plywood, fabric, and dope—it's even more interesting. Is there a more attractive full-scale to pattern a twin-powered R/C model after?

Many of us have been impressed by a twin in flight; it's distinctively different and has excellent performance. We can be inspired to build one until we remember stories of matching engine outputs and marginal control with one dead engine. My experience with twin engines was with a couple of spectacular performers until I had an engine quit at the wrong time, resulting in disaster.

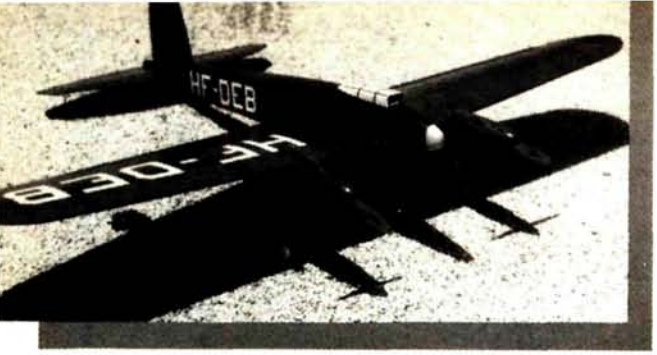
With electric power, however, you can use multi-motors *without* the usual engine-associated problems. The better motors are closely matched in power output, and there is the advantage of operating them from the same battery supply. All motor power


***Type:*** *Sport electric*
***Wingspan:*** *60 inches*
***Wing Area:*** *625 square inches*
***Weight:*** *80 ounces*
***Wing Loading:*** *18 ounces/square foot*
***Channels:*** *4*
***Power:*** *Twin-Astro 05*

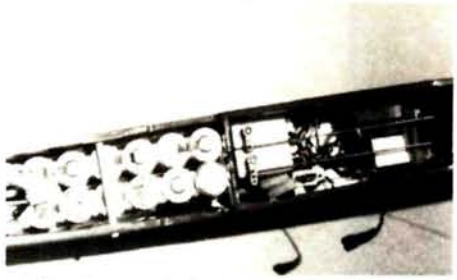





FULL-SIZE PLANS AVAILABLE...PAGES 120, 121



The Skeeter is a "sorta-scale" Mosquito that won't win the Scale Masters, but sure flies neat.

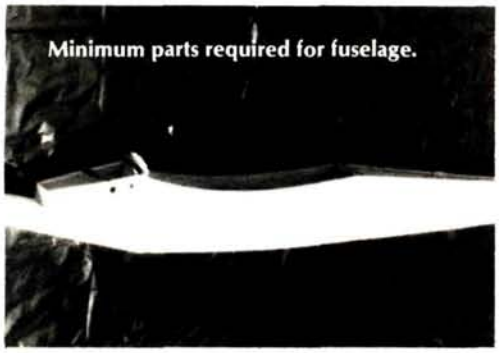


Gobs of room in the fuselage for batteries and airborne radio equipment.

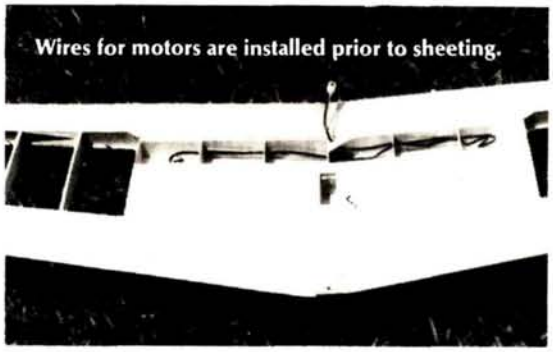
remains equal from start-up to last gasp, so you can operate an electric-powered twin with considerable assurance. The operation is very much like that of a single.

I had other reasons for building the Skeeter besides my desire for a twin. I presented the details in the September '85 issue of *M.A.N.*, if you're interested, but suffice it to say that my projections indicated there could be a power/weight ratio improvement by using two small motors instead of one large one. I also felt there could be a gain in efficiency with two propellers. The results are great, with a 25% improvement in the power/weight ratio and performance indicating a nice gain in propeller efficiency.

*(Continued on page 117)*



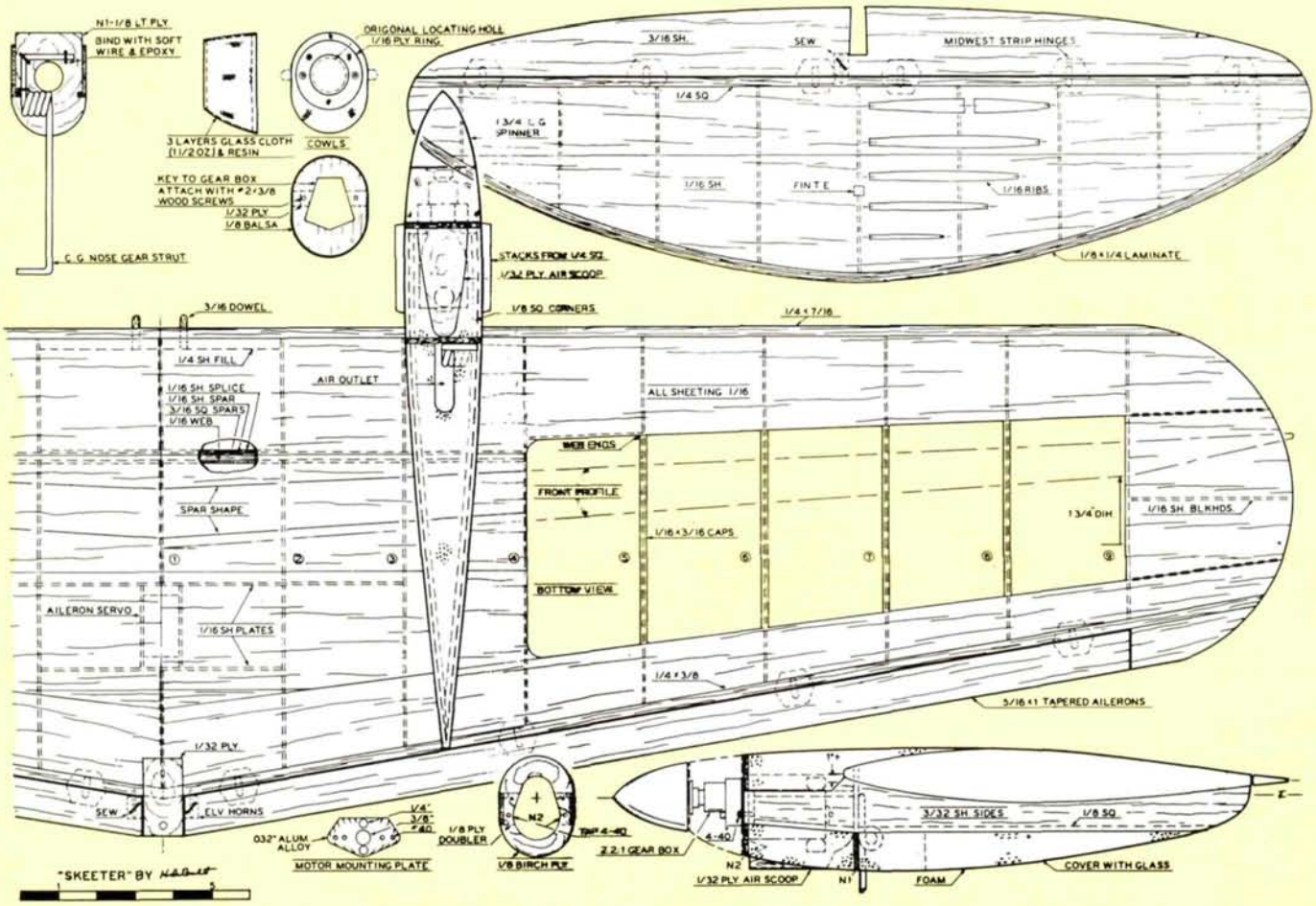
Minimum parts required for fuselage.



Wires for motors are installed prior to sheeting.

Nacelles are foam.

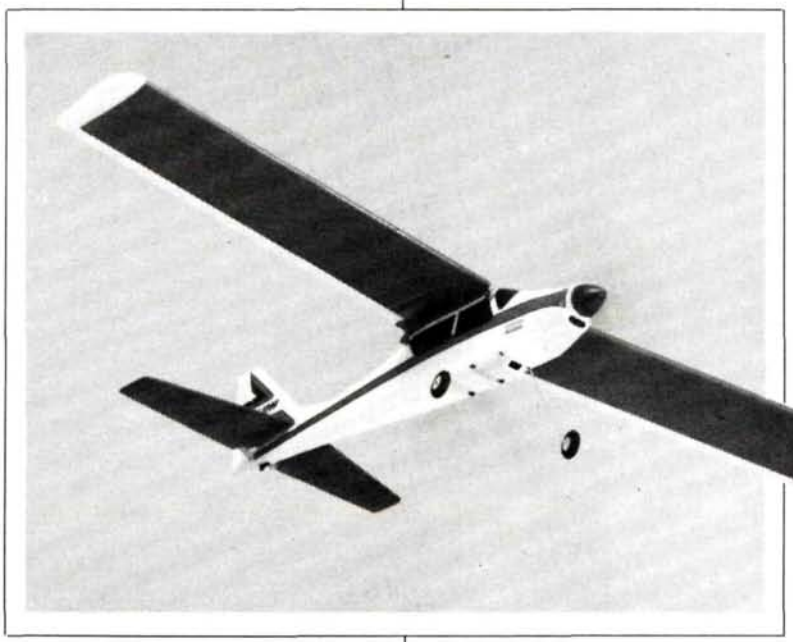
FULL-SIZE PLANS AVAILABLE...PAGES 120, 121



# Electrics Are User-Friendly

by CHRIS CHIANELLI

AS USUAL, I SEE EVERYTHING through sport-flier eyes. Up until recently, electric flight has been shrouded somewhat in a high-tech, competition-oriented, for-the-purist-only veil of mystery. Why some choose to ignore the Sunday flier is beyond me. After all, he makes up 85% of the selling market. And what could suit a sport-flier better than clean, quiet, flip-of-the-switch-type flying? I personally find electrics to be a wonderful change of pace now and then. I always have at least one in my hangar hiding amongst the methanol monsters.



Fortunately smart manufacturers are beginning to realize that the average guy is not to be looked down the nose at. We should be catered to if products are to be sold. Consequently, we're beginning to see more diversification in the offing. I'm hearing fewer wisecracks from my buddies about how "all electrics look alike" or "those things are a bunch of boring free-flight and glider conversions." I've had many friendly arguments with my flying cohorts in the past about this particular stigma electrics have had attached to them, but things are definitely changing. Companies like Cox, MRC, and Kyosho have already brought us many ARF alternatives.

What we need are more enticing balsa kits to excite the non-believer. Some perfect examples are Astro Flight's Porterfield Collegiate and Partenavia P68 Victor (twin 05 power), and the Davey Systems' Miss Los Angeles Brown B-2 Racer, a great-looking, great-flying, low-wing electric of a Golden Age classic. Let's face it, a great many sport fliers love a model that looks like something. That's just the way we are.

Let's talk about the advantages of electrics. Some are obvious; no mess, no cleaning, no vibration, and instantaneous starts. I still feel I've left something undone when I fly an electric instead of a glow-powered model. I always feel that something has been left un-fiddled with. I'm almost always wrong!

Then there's the sneaky-pete in some of us who just loves to fly in close-to-home places were neighbors would otherwise complain. I guess those of us inclined to such clandestine flying snicker because for some reason we feel we're getting away with something...what fun.

Then there's that spot close to work that you always thought would make a nice flying site. With daylight savings time you can get in a lot of stick time that would otherwise have to wait 'til the weekend.

But for me the simplicity of the user-friendly electric is really appreciated when I'm on the road. To pull off the road to some pretty country field with my wife Barbara and have some lunch, let the dogs run, and listen to the wind whistling while it works aerodynamic wonders around the form of my latest electric creation is pure heaven.

In any case please make darn sure there's no R/C field close by. I know the last thing anyone wants to do is shoot down a fellow modeler!

Granted there are new modes of thought that the modeler wishing to get into electrics is going to have to acclimate himself to. There are new methods of construction, a different approach to propping as related to battery duration, charging, a bit more soldering, cleaning commutators, replacing brushes, leaving out fuel tanks, and so on. But the key word is "new," which does not mean "difficult," just different. I guess it's simply the human reluctance with the unknown or the as yet unexplored.

There are some who say electrics don't have power. That's not really true any more with the latest technology. Others say that the duration isn't what you can get from a glow engine. To date, that is still a problem. It's not a big problem, but nevertheless, the limitations are there. But wait, in the not-too-distant future a technological boom is waiting in the wings. The tip of the iceberg is not yet in sight but, believe me, that iceberg is there just beneath the surface. When it does surface, you're going to see an electric boom in this hobby, the likes of which we've never seen.

Remember, you heard it here first. ■

# Basics of R/C Helicopters

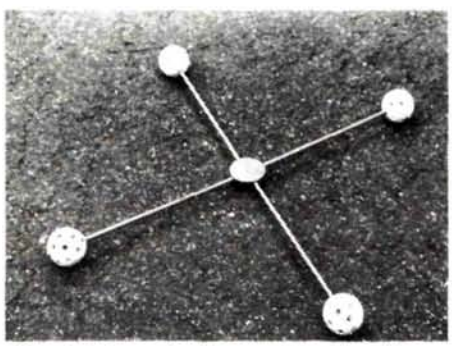
Mastering the art of hovering is one of the most difficult tasks for the beginner and takes practice.

by DR. DAVID TROST

NOW THAT YOU'VE decided which helicopter kit to purchase, the next step is assembly. As stated in the first installment of this series, 50% of flying a model helicopter is learning how to build it and set it up correctly.

The assembly manuals included with most kits on the market are quite good but the beginner always has questions that aren't covered in the manuals. The best way to avoid problems when building your machine is to seek the help of an experienced helicopter flier. He'll be able to help, many times over the phone, with the little problems which can sometimes plague the beginner. I'm not saying that a novice can't successfully assemble and set up a helicopter by himself; it has been done many times. But some people are less mechanically inclined than others and might have problems which the manuals don't cover. The purpose of this article isn't to give any specific details about specific machines, but rather to try and relate general construction techniques which apply to all machines.

Building a model helicopter is not merely bolting pieces of metal together. A machine built like this will have many problems with vibration and will never fly correctly. Parts must be carefully aligned during assembly for dependable service and ease of setup. Only basic tools are needed to construct a helicopter. The kits include the appropriate Allen wrenches but the modeler needs to supply the other necessary tools. Unfortunately, most helicopters use small metric hardware which most modelers don't already own. Several manufacturers offer tool sets which contain nice, high-quality tools and there are some inexpensive metric tools available at some hardware stores. I've found that a ball driver for 3 mm socket head bolts (available from Miniature Aircraft Supply, Du-Bro, and others) is a very useful tool since most of the bolts on helicopters are 3 mm bolts.



Like training wheels on a bicycle, this arrangement helps prevent inadvertent rotor damage.

Once your confidence is up, the simple removal of a few rubber bands gives you aerobatic potential.

**Dr. Trost displays the proper orientation of pilot to aircraft for insured coordination.**

Another great tool is the four-way metric box wrench which comes with Tamiya car kits.

Follow the assembly manual carefully and make sure that all bolts and screws that don't have nylon self-locking nuts are secured with a liquid lock-nut compound. Use a medium-strength formula so the parts can be disassembled when necessary. Take care when assembling the main side frames so they aren't warped. This can be avoided by keeping the bolts slightly loose when assembling the frames and all supports. Then tighten all the bolts completely, periodically checking alignment during the process. Keep the bolts slightly loose at the engine and at the main frames until they are aligned, so that the main frames are not unduly stressed.

As anyone who flies model airplanes or runs model boats knows, an out-of-balance propeller can cause severe destructive vibration and reduce rpm significantly. The problem of vibration is one of the greatest in model helicoptering. Everything that spins or rotates must be carefully balanced or aligned. On some machines a long shaft runs through the clutch to the top of the machine for engine starting. The trueness of this system is essential in keeping vibration to a minimum.

Since it spins at 13,000 rpm or higher, the runout (wobble) at the top of the startshaft should be less than $^{5}/_{1000}$ inch. The best way to measure this is with a dial indicator. Dial indicators are available from tool suppliers but are expensive. Some machine shops will sell you a used one. If you can afford a dial indicator, it's a good investment. The shaft must be true if the helicopter is to run correctly so try to borrow a dial indicator or ask someone who has one to help you.

The procedure of truing is really quite simple but can be quite time-consuming. First, remove the glowplug and loosen the engine backplate so the engine spins freely. True the fan by spinning the engine with the dial indicator in place. If it isn't true, loosen the nut, rotate the fan on the engine, tighten the nut, and check it again. Repeat this procedure until the fan is true. Then mount the clutch and startshaft. Check the bottom of the shaft first. If it isn't true, unbolt it, rotate it 90°, and try again. Pick the best of all possible positions. True the top of the shaft by carefully bending it by hand at the clutch.

If a dial indicator can't be obtained, runout can be approximated by clamping the engine and a piece of music wire gently in a vice. Bend the music wire so the tip is close to the object to be checked. Rotate the shaft and observe the gap between the wire and the part being checked. The goal is to have the gap remain the same as the engine is spun.

Repeat the process of bending the shaft and checking until the runout is as small as possible. This might take a while and can be very frustrating but the time is well spent. The vibration from a wobbly startshaft is at a high frequency and is very destructive to the side frames, causing them to fatigue and crack. One way to check whether the startshaft is true is by observing the fuel in the tank while the helicopter is hovering. If the fuel appears to be boiling, the startshaft isn't true.

On some helicopters the drive hub must be removed in order to install the flywheel. On many engines the drive hub merely slides off, but on some the hub is wedged on to a tapered cone and can't be removed without a special puller. If you have one of these pullers, great. If you don't, do not try to pry it off with screwdrivers or pound it off with a hammer; the crankshaft can be easily bent. A simple hub puller can be made from a car battery terminal puller. File down the prongs until they fit the groove in the hub.

It's good practice to run in the engine and set up the carburetor on an engine test stand prior to installing it in the helicopter. Set it up with the helicopter muffler on and run a standard airplane propeller. Adjust the needles so that the engine will idle for extended periods without loading up and will accelerate smoothly and quickly to full power without sagging.

During assembly remember to place a drop of heavyweight oil on each bearing as it's installed. If your machine has a music wire tail rotor drive system, oil or grease the wire well before installation. The gears in the drive system shouldn't bind or be too loose, however, there should be some play between the gears. The main gear/clutch pinion gear mesh can be adjusted by loosening all the bolts which hold the engine and the startshaft bearings, if present, and sliding the engine in the mounting holes until the mesh is right. Also check to see that the gears are parallel to each other. The tail rotor drive gear, if present, can usually be adjusted in the same manner. Don't grease the drive gears; the grease will only pick up dirt making it an abrasive paste which will rapidly wear the gears.

A helicopter is a vibration environment. The radio receiver and battery must be well isolated with plenty of foam

*(Continued on page 125)*

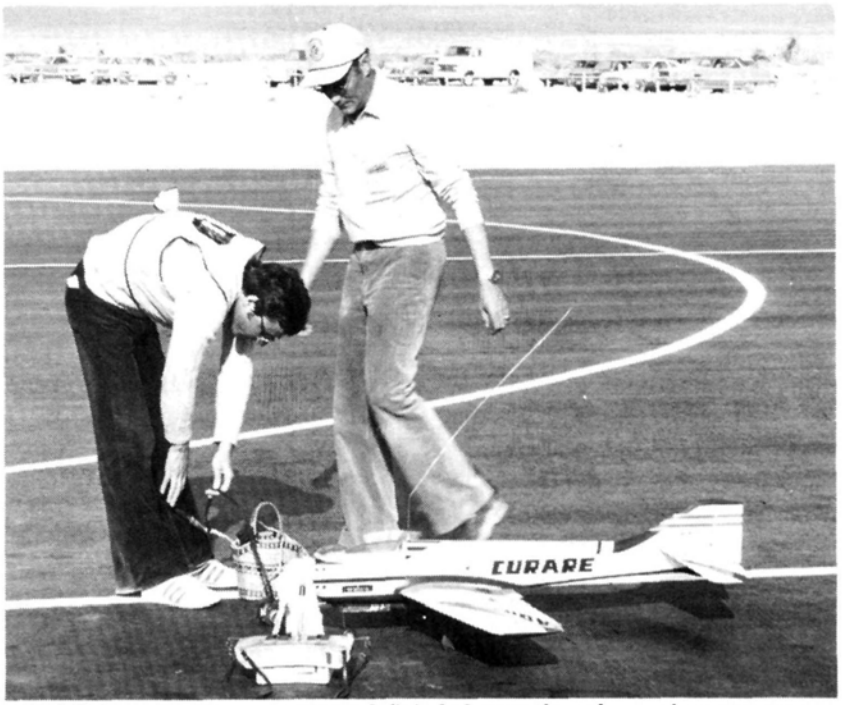
# Pattern Matters

by MIKE LEE

I REALIZE THAT THE FAI Turnaround pattern is not everyone's favorite subject, but here's some news regarding the FAI schedule. The reason I'm doing this is so that those who aspire to be contenders for a Nationals or World title can know what's up.

What's up is a change in the rules for FAI. Again, I have to give credit to the National Society for Radio Controlled Aerobatics (NSRCA) and Ron Chidgey, an American representative on the FAI CIAM committee. Ron reports that two changes have been agreed on by the CIAM Plenary group. One affects the flight "box" we fly in and the other deals with noise. Let me quote the ruling for you:

"Paragraph 5.1.8 Marking. Maneuvers must be performed where they can be seen clearly by the judges. Center maneuvers should be performed in the center of the maneuvering area, while Turnaround maneuvers should not extend past a line 60° left and right of center. Vertical height should not exceed 60°. Maneuvers should be performed along a line of flight not more than approximately 150 meters in front of the judges [450 feet]. Infractions of this rule will be cause for downgrading by each judge individually and in proportion to the degree of infraction. The maneuvering area will be clearly marked with white vertical poles, a minimum of 100 mm [4 inches] and a minimum of 4 meters [13 feet] high, placed on center and 60° each side of center on a line 150 meters in front of the judges. White [or contrasting] lines, originating at the pilot's position and extending outward at least 50 meters [160 feet], will also be used to mark the extreme limits [60° left and right of center] of the maneuvering zone. Audible or visual signals to indicate violations of the maneuvering zone are not to be employed. The judges shall be seated not more than 10 meters [30 feet] behind the pilot's position [the apex of the 60° lines] and within an area described by the extension of the 60° lines to the rear of the pilot."




**World Champion Hanno Prettner definitely knows the rules, an important prerequisite to sustained success not only in Pattern but in virtually every aspect of R/C modeling.**

Wow, what a mouthful! The best thing I like about this new ruling is the fact that any out-of-bounds maneuver must be judged by each individual judge and without any signal from an outside source indicating an out maneuver. I also think that the box is a bit bigger than it was, due to the fact that we can now fly some 450 feet out, instead of the 300 feet now practiced. Four hundred and fifty feet is a football field and a half away from you. It'll be nice for those who fly faster planes.

I'm not so pleased with a judge sitting 30 feet behind me if he pleases. That's quite a distance back and the farther back from the actual apex of the boundary lines you are, the narrower the box. It's simple geometry, folks. I'd rather have the judges sit in front of me than 30 feet back. Hopefully, this extreme won't be used often.

The next ruling has to do with the noise measurement. Let's take a look.

"Paragraphs 5.1.2 and 5.1.8 General Characteristics of F3A Models. The maximum noise level will be 98 dB measured at 3 meters from the centerline of the model, with the model placed on the ground at the flying site. With the motor running at full power, measurement will be taken at 90° to the flight path on the right-hand side and downwind from the model. The microphone will be placed on a stand 30 cm [12 inches] above the ground in line with the motor. No noise-reflecting objects shall be nearer than 3 meters to the model or microphone. The noise measurement will be made prior to each flight. *(Here's the clincher, guys—MSL)* In the event a model fails the noise test, no indication shall be given to the pilot, and/or his team, or the judges, and both the transmitter and the model shall be impounded

*(Continued on page 116)*

# Engine Review Round-Up

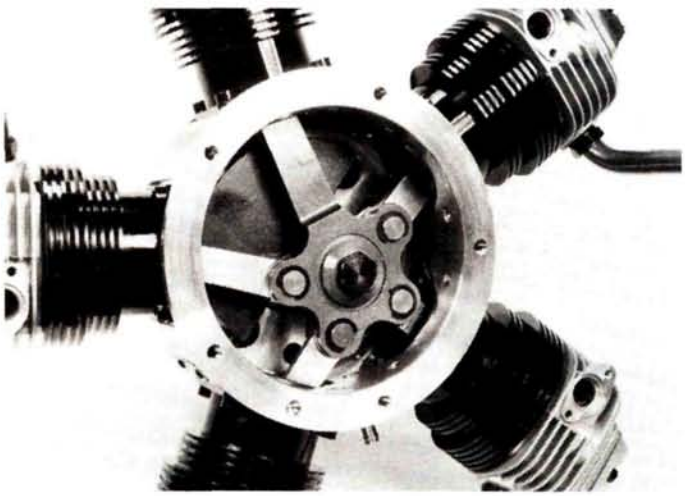
by PETER CHINN

## O.S. FR5-300 "SIRIUS"

**Superb 5-cylinder Sirius radial four-stroke exemplifies the O.S. effort for model engine progress.**

### SPECIFICATIONS

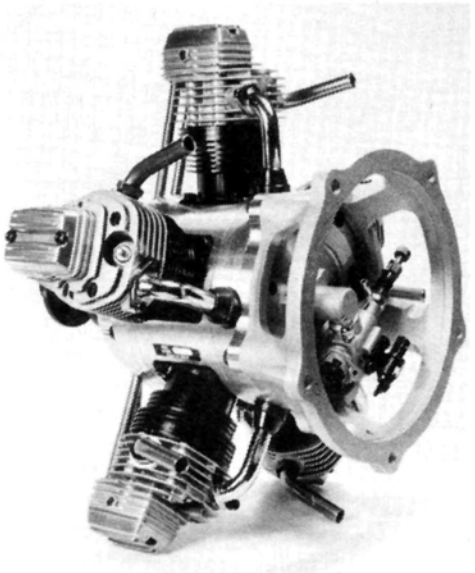
*Type:* Air-cooled five-cylinder radial four-stroke-cycle, with pushrod operated overhead valves.
*Bore:* 24.0 mm (0.9449 in.)
*Stroke:* 22.0 mm (0.8661 in.)
*Displacement:* 49.76cc (3.037 cu in.)
*Nominal Compression Ratio:* 8.5:1
*Speed Control:* Single O.S. adjustable automatic mixture control carburetor.
*Checked Weight:* 2.70 kg (5.95 lb) including cast aluminum firewall mount.
*Mounting Dimensions:*
*Overall diameter:* 234 mm
*Length from prop driver face including firewall mount:* 158.5 mm
*Overall diameter of mount:* 136 mm
*Mounting bolt circle radius:* 61 mm
*Manufacturer's Claimed Power Output:* Not stated
*Manufacturer:* O.S. Engine Mfg.Co.Ltd., Higashisumiyoshi-ku, Osaka 546, Japan.
*U.S. Distributor:* Great Planes Model Distributors Company, P.O. Box 4021, 1608 Interstate Drive, Champaign, IL 61820.



**With backplate and induction assembly removed the engine's impressive internal workings are revealed.**

THIS YEAR has seen the introduction of a large number of new and, in many cases, exciting engines. The need to cover them as quickly as possible, via engine round-ups, has meant that full test reports on individual engines have had to be postponed, but the new O.S. FR5-300 "Sirius" radial is one for which a full test treatment has been reserved for a future issue.

With the announcement of the Sirius, the O.S. company has rounded off what is unquestionably the most complete range of four-stroke-cycle engines currently available to the model aircraft enthusiast. Covering just about every type and size, the O.S. four-strokes at present number ten different models, i.e., five single-cylinder engines (FS-20, FS-40, FS-61, FS-90 and FS-61), the three "Gemini" flat-twins (FT-120 Mk.II, FT-160 and FT-240), plus the only horizontally-opposed four-cylinder four-



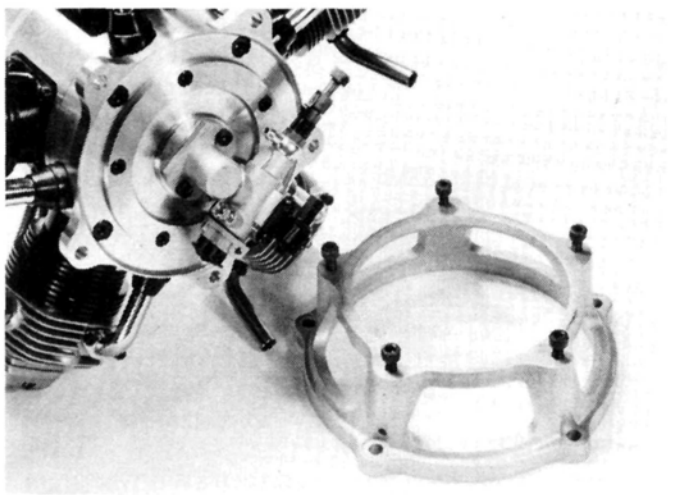
**Pistons, valves, and rocker gear are identical to O.S.'s FS-61 but the rest is original.**

stroke (the FF-240 "Pegasus" featured in the July *M.A.N.*) and, now, the FR5-300 five-cylinder radial.

As every engine buff knows, O.S. is not the first manufacturer to have produced a model radial. That distinction belongs to the Morton Brothers of Nebraska who, in the mid nineteen-forties, produced the 0.92 cu in. five-cylinder Morton M-5 radial, first as a machine shop project and then as a complete ready-to-run engine. Later, M-5 manufacture was taken over by the Handicraft Division of the Burgess Battery Company. Within a couple of years, however, the Burgess M-5 was off the market, unable to compete at a time when the demand was for powerful, lightweight, inexpensive two-strokes for free-flight and, particularly, for the control-line models that were all the rage at that time. Radio-control was very much in its infancy. Nowadays, of course, the M-5 is a much-prized collector's item.

Thirty years after the introduction of the Morton M-5, the first of the Technopower radials appeared in the U.K., later to be manufactured in the U.S. When the original Technopower five and seven cylinder engines were designed, back in the early seventies, the emphasis was still very much on light weight. Chainsaw engined giant-scale models had yet to appear and all engines were expected to be suitable for R/C aircraft built within the official international (FAI) weight limit of 5 kg (11 lb), even though the engines themselves had substantially larger displacements than the FAI 10cc (0.61 cu in.) limit. Thus the Technopower engines were, like the M-5, essentially lightweight designs and even the current 1.39 cu in. "Big-Bore"

*(Continued on page 91)*

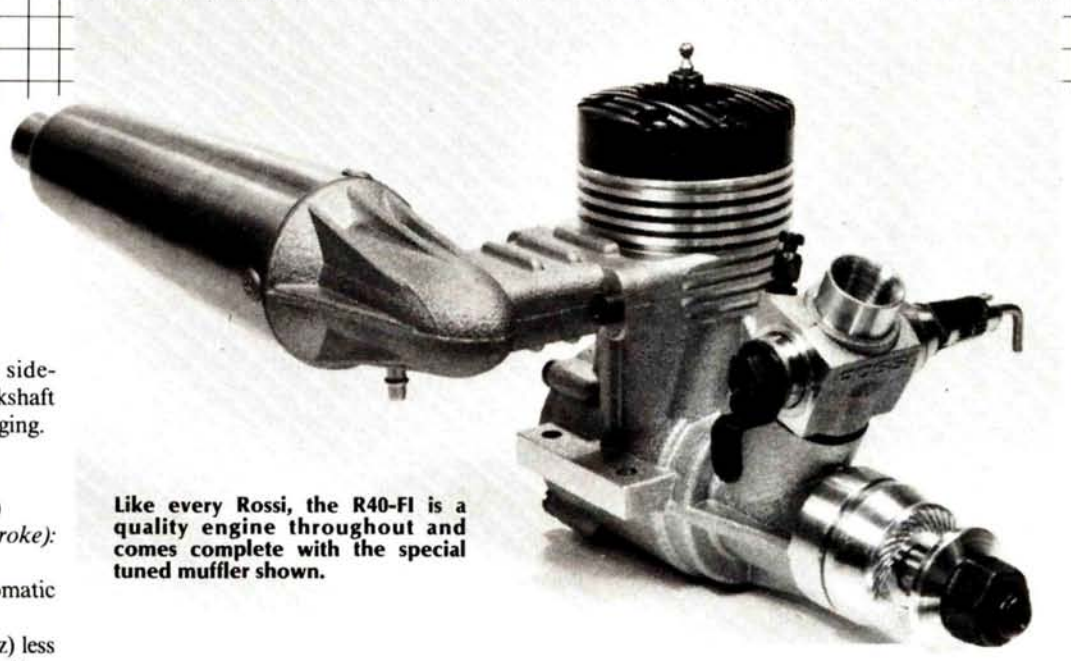


**Cast aluminum radial mount allows convenient mounting with access to carburetor.**

# Engine Review Round-Up

by PETER CHINN

# ROSSI R40-FI



**Like every Rossi, the R40-FI is a quality engine throughout and comes complete with the special tuned muffler shown.**

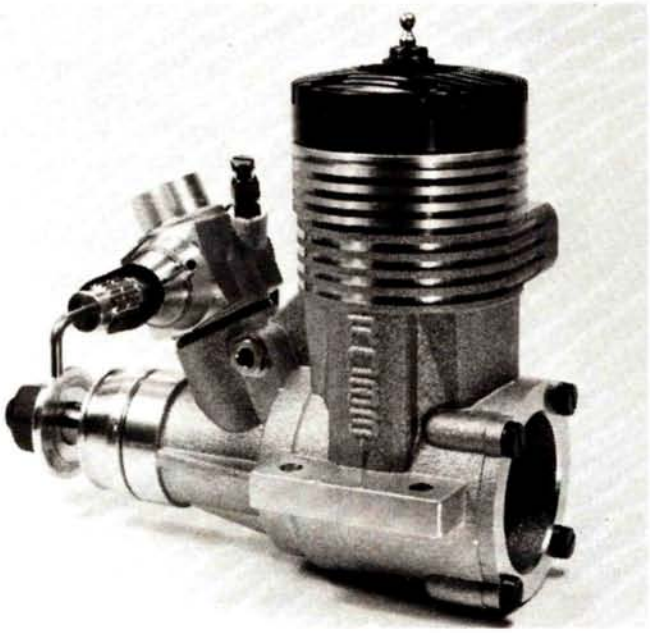
## SPECIFICATIONS

*Type:* Air-cooled single-cylinder side-exhaust two-stroke-cycle with crankshaft rotary-valve and Schnuerle scavenging.
*Bore:* 21.0 mm (0.8268 in.)
*Stroke:* 19.0 mm (0.7480 in.)
*Displacement:* 6.581cc (0.4016 cu in.)
*Nominal Compression Ratio (full stroke):* 12.5:1
*Speed Control:* Rossi adjustable automatic mixture control carburetor.
*Checked Weights:* 428 grams (15.1 oz) less muffler; 496 grams (17.5 oz) with muffler.
*Mounting Dimensions:*
*Crankcase width:* 37.5 mm
*Length from prop driver face:* 91 mm
*Height above CL (less glowplug):* 70 mm
*Bolt hole spacing:* 45x24 mm
*Manufacturer's Claimed Power Output:* 1.95 bhp at 17,000 rpm.
*Manufacturer:* Rossi Electronics Bresciana s.r.l., 25060 Cellatica, Brescia, Italy.
*U.S. Distributor:* Model Rectifier Corporation, 2500 Woodbridge Ave., Edison, NJ 08817.

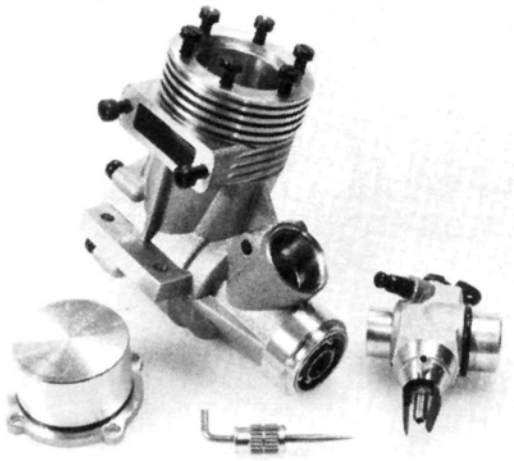
IT WOULD not be inappropriate to say that the Rossi is the Ferrari of the model engine world. There has never been a slow Ferrari nor a slow Rossi. Both have been world championships winners and both are manufactured in Northern Italy, the Rossi exhibiting something of the Italian engineering artistry for which the Ferrari is famous.

Enzo Ferrari first became famous in the automobile racing world by running a highly successful team of Alfa-Romeo cars, before embarking on the production of his own cars. The Rossi name first hit the modeling headlines back in the nineteen-fifties when two brothers, Ugo and Cesare Rossi, began heading control-line speed results (culminating in a World Championship win) by modifying Super-Tigres to go faster than anyone else's. Shortly afterward, they set out to produce an engine of their own that would succeed the famed American McCoy 60 Series 20 that had dominated 10cc class C/L speed events ever since 1948. As late as 1963, in the three U.S. Nationals Class C categories, six of the top nine places were taken by McCoys but, in the following year, Rossi Speed-60s recorded first, second and third fastest times in the Senior and first and second fastest in the Open speed events. In the mid-sixties, the brothers began an R&D program on a 2.5cc (.15 cu in.) engine for the FAI World Championship Speed and Free-Flight Power classes. That exercise took five years, but when the production Rossi R.15 appeared, it immediately showed its potential by winning first places in the 1971 World Free-Flight Championships and the 1972 World C/L Speed Championships.

Since that time, Rossi two-strokes have been produced in many types from .21 cu in. to 0.90 cu in. for other high



**Although classified as a sport engine, the new Rossi is capable of high performance.**



**Finely executed machine-furnished castings are a Rossi hallmark. Carburetors are available in two choke sizes.**

**R40-FI has a 17 mm shaft for generous porting. Note two-piece head.**

performance applications, including pattern R/C models, racing boats, R/C cars, and ducted-fan models. Nowadays, the two Rossi brothers produce engines independently. Rossi Electronics Bresciana is under the control of Ugo Rossi and also distributes Japanese "JR" radio control systems in Italy under the Rossi trademark, while Cesare Rossi's engines are marketed under the name "Novarossi."

The new Rossi R40-FI illustrated here is described in Ugo's literature as having been specially designed for "sport" flying, including "fun" flying by "first-time" fliers. To most people, this would conjure up a picture of an orthodox and unpretentious design, probably built down to a price and having a modest power output. In truth, a less appropriate description for the R40-FI could scarcely be imagined. Rossi claims that the R40-FI has a power output of 1.95 horsepower at 17,000 rpm, which is twice as high as one would normally expect of a "sport" type R/C 40. The 1.95 bhp rating may be slightly flattering, but there is no doubt that the R40-FI has all the makings of a very powerful motor.

The power of any internal combustion engine is heavily dependent on its volumetric efficiency. In a two-stroke motor,

*(Continued on page 110)*

# Electric Motors

by MIKE LEE

FOR WHATEVER reason, certain standards always seem to arise within our hobby, particularly on the entry or "maybe I'll give that a try" level. This is definitely the case with the small, powerful, and very inexpensive Mabuchi 540. Low price is definitely what we need to persuade the skeptic to give it a go. The 540 has done a lot to make the transition from the traditional gas-powered model to the increasingly-popular electric model. Its advantages are many: it requires little voltage, it has a high energy output, there are no residual exhaust products, and it has the ability to be ready at the flick of a switch.

In order to get the most from these little powerhouses, you should know what makes them tick. The theory on how they work isn't as important as how to maintain them. I'll take you for a detailed tour of the common electric motor so you'll know how to get the most from your investment.

The motor I'm using for this tour is the ball bearing LeMans 240 from Kyosho, courtesy of Great Planes Model Distributors*. Yes, there are much more sophisticated and expensive motors, but since the first experiences of the inquisitive sport flier are more likely to take place with a motor of this type, I thought its use was only appropriate.

Besides coming as stock equipment in some Kyosho kits, such as the Zero and the Valencia, the 240 with its reduction unit is also quite suitable for other balsa kits on the market; Davey Systems' Curtiss Robin and Miss L.A., Electric Model Designs' Lightning or Sky Night, or Craft-Air's Piece of Cake, to name just a few.

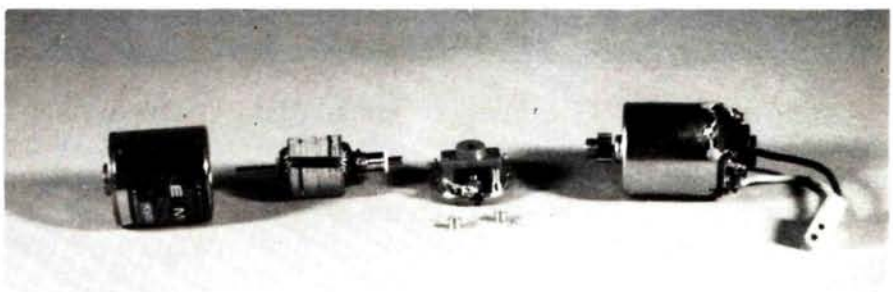
**The LeMans electric racing motors by Kyosho are high-quality but still require proper care and attention.**

The basic motor can be separated into several distinct components. Each component is nothing without the others, so you have a "one for all and all for one" assembly. Each component contributes something to make the whole motor work.

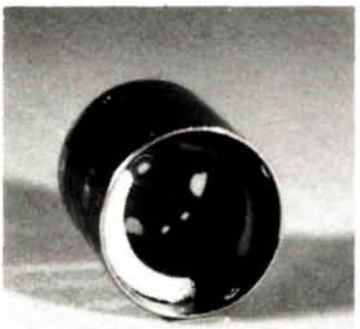
The components include the can or casing, the endbell, the armature and commutator, and the magnets. As you can see, it's not really all that complicated. The motor can is the first thing you see in any motor. It is the main casing into which all other components fit, and it's usually made of a ferrite-based metal, more for economics than effect. The motor itself is normally mounted by the can, and the can has cooling slots for ventilation.

The can's main function is to hold everything together and to house the magnets. The end bearing can be found at the end of the can and this bearing supports the armature shaft. The other end of this armature shaft is supported by the end bearing found in the endbell. Bearings are either bronze Oilites or ball bearings, depending on the make and model.

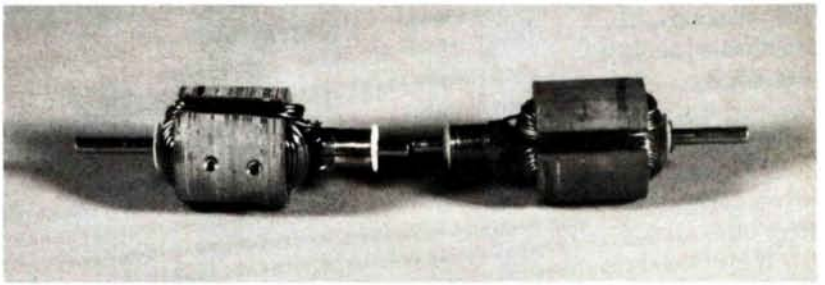
The other main function of the can is to prevent foreign matter from fouling the movement of the armature, and to



**Disassembly of a typical electric motor shows from left: the can, the armature, and the endbell. On the right is a fully assembled motor.**



**The motor can, showing the internal magnets and cooling vents. Also note inside is the main bearing to support the armature shaft.**



**Comparison photo of a balanced armature on left and an unbalanced armature on right. Note the balancing holes drilled in the balanced armature.**

act as a heat sink for the armature while it's in operation.

My example motor features a rolled steel main can with a machined aluminum end plug. This was probably done to prevent magnetic foreign material from being attracted to the end plug and later on being sucked into the cooling vents. A ball bearing is press-fit into the end plug from the interior side of the plug and this prevents dust and dirt from working their way into the bearing and wearing it out. A generous amount of cooling vents are provided in the end plug.

The next component of the motor is the endbell. The endbell houses the second of two bearings, plus the armature contact brushes. On many modern motors, the endbell has the brush plates, wire contact lugs, brush springs, and mounting tabs or screws.

The main function of the endbell is to provide the electrical energy from the power source (the batteries) to the armature. Other functions include support of the armature itself, timing of the motor, and motor ventilation.

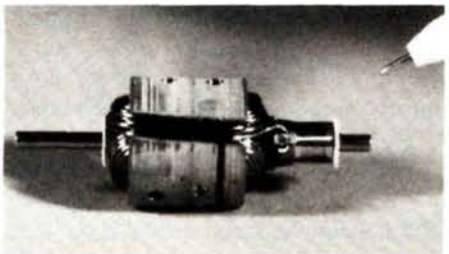
Delivering electricity to the armature involves several things. The process begins with power being provided from the battery to the power lugs. The lugs are electrically connected to the brushes, either by plates or by wire shunts, or both. For all practical purposes, the plates should not cause any electrical resistance in the flow of power to the brushes, hence the use of shunts in most racing motors.

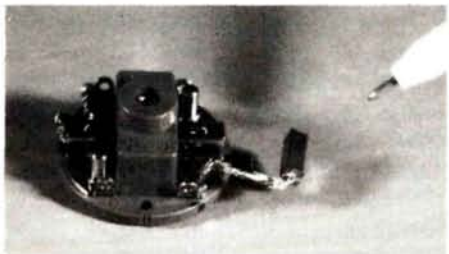
Shunts are high-voltage, low- (if any) resistance braided wires connected from the power lugs directly to the brushes. They prevent any power loss due to electrical resistance.

The brushes are the electrical contacts with the armature. Made of a graphite material, they are highly conductive and non-abrasive. Functionally, the brushes maintain physical contact with the armature commutator section in order to provide the flow of power to the armature poles. Loss of direct contact results in loss of electrical contact and the motor ceases to work. The brushes are also designed to prevent arcing, which results in the pitting of the commutator as well as brush disintegration.

The endbell also has a lot to do with the motor timing. Not unlike the timing of a full-size V-8 engine in automobiles, the timing of electric motors will dictate how fast or slow the armature will turn when running. And, again like the full-size engine, too much advance or retard of the timing can have serious effects on performance.

*(Continued on page 76)*





**Far left: The heart of any motor is the armature. Pen points to commutator where the timing is and where electrical contact is made. Left: Endbell portion of the motor holds the second of the two main bearings.**

# Radio Control News

by ART SCHROEDER

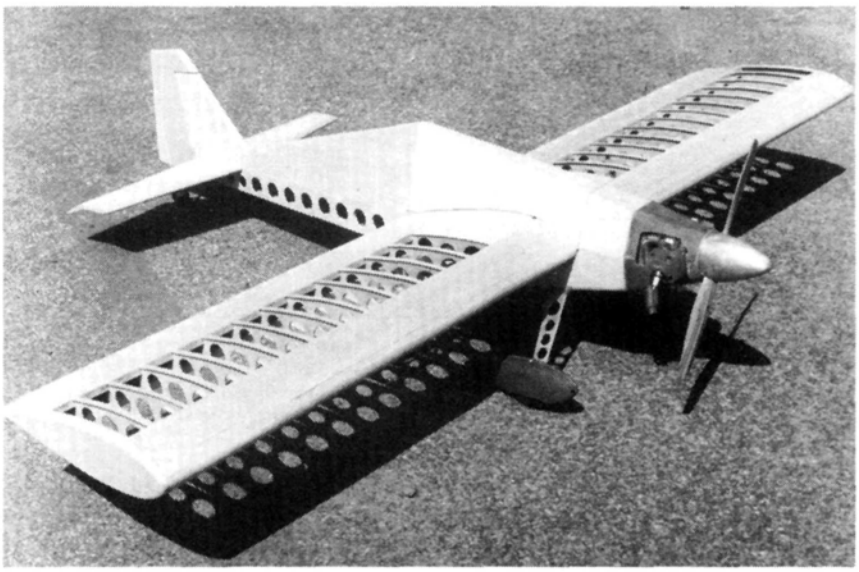
THE FIRST "GIANT" airplane I had anything to do with was an Aeronca C-3 built by a friend back in the early '70s. The airplane was overbuilt and spanned about 7 feet or so with an O&R chainsaw engine for power. Because of weight, pathetically low power (that engine was choked down with a typical .60 engine carburetor), and a poor propeller, the airplane was at the bottom of the performance range.

In my eyes the thing was huge—I had never flown anything so big, so heavy. Surely this was as "big" as my modeling experience would ever get. The C-3 flew, not great—but it did fly! And we all learned a lot; not the least of which was that normal modeling techniques simply don't work when models are giant in size.

My next "big" effort was a Span Aero J-3 Cub that remains one of the most satisfying model airplanes I ever had. It's a pity this airplane is no longer available in kit form. It had some of the most innovative construction techniques I've ever seen, including a finished fiberglass cabin section, aluminum tube wing spars, and aluminum tube framework tail surfaces. The Span Aero Cub was one of the first models to use a composite materials structure. It was light for its size and flew beautifully on its 8-foot span and O.S. 80 power. Surely this was "big"!

Not much later, I played with geared engines in various airframes and finally tried the Quadra; the first engine that really was suited to giant scale. The Quadra was really "big." It was so large it almost frightened me. After all, it turned 18-inch propellers.

I've built a lot of "big" airplanes in the last several years and I've come to learn that they're a lot of fun and most rewarding. There's nothing in aeromodeling so realistic and so close to full-scale. To be sure, they require respect and solid building and maintenance practices, but anyone willing to put in the effort will find success with the "biggies." And, properly done, they are as safe as any modeling form.



**To be featured in next month's M.A.N., the Big Hots follows traditional concepts of modeling but is bigger. The discussion of bigger being better is explored further in the text.**

If you haven't tried the giants, I encourage you to do so. The first step should be joining the International Miniature Aircraft Association* (IMAA). Your membership puts you in touch with thousands of "gianteers," gets you a quarterly publication chock full of useful information, and the organization acts as a direct representative to the AMA in giant-scale matters.

Along with my own efforts, I've seen a number of the celebrated giant-scale airplanes that have been built. Some of these are really huge and include Don Godfrey's B-25, Bob Campbell's B-29, and Byron Originals' C-47. These go way beyond the norm for most of us, but they sure are impressive to watch.

Indeed, things seem to be getting bigger and bigger—particularly powerplants—at local fields. There was a time, years ago, when I viewed the K&B Greenhead 45 as huge. After all, a .35 was a big R/C engine back then. In time, the .60 became a norm and was not perceived as inordinately large. Today's .60s seem small when viewed alongside 1.20 and 2.40 four-strokes or ST 2500s or 3000s. Even Rossi's .90 (which is often used by Dave Platt) tends to diminish the size of the usual .60. And, of course, the Quadra that really got things going has been replaced by 50cc and 82cc engines that are really large. I had the Q35 and Q82 on my bench recently and there is no comparison; the Q35 is now the "small" Quadra. It's hard to say just what "big" is anymore.

The trend toward bigger and bigger engines and airplanes requires greater care in setting up giant-scale models. Unfortunately, I'm still seeing small and insufficient hinging, pushrod arrangements that are weak and sloppy, 4-40 bolts where much larger sizes are needed, and small clevis connections. But it's some of the building that truly frightens me with poor fitting, improperly glued joints, poor surface alignment and warps, insufficient firewall strength, and landing gears that defy description.

If you're not a reasonably competent builder, please get a friend to help with construction and alignment of your first

*(Continued on page 127)*

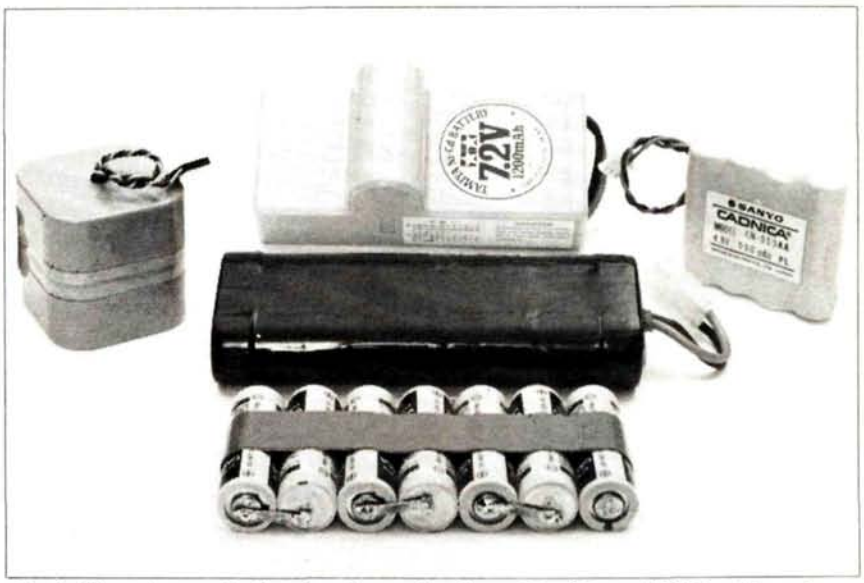
# Electric Chargers

by CHARLIE KENNEY

THE SUBJECT of electric flight came to my attention back in the early 1970s by way of an engineer named Bob Boucher. Bob had started a company called Astro Flight in California. He was a model glider enthusiast and I reviewed Astro Flight's first kit, the Malibu, in the December 1970 issue of *M.A.N.* Some years later, again in *M.A.N.*, I reviewed the Astro Flight RF-4. I kept in touch with Bob because he was doing unprecedented work on electric motors and solar cells. His work with Dr. Paul MacCready's Gossamer Penguin and Solar Challenger has been well documented. Bob also introduced me to electric flight when I reviewed the Super Monterey for *M.A.N.* in November 1981. His pioneering work with Samarium Cobalt Motors has led to various world performance records for electric-powered R/C-controlled models.

For this particular issue of *M.A.N.*, I was asked to discuss nickel-cadmium batteries (Ni-Cd) and chargers. In order to do this, I must discuss the various methods of charging Ni-Cd batteries: overnight, quick, fast, and trickle.

The definition of charging rate is the amount of electrical current that is going into the batteries under charge. This is usually measured in milliamperes (one one-thousandth of an ampere) for the kinds of chargers we use. These are the various types of charges:




**Typical batteries used in fast charging applications: 600-, 800-, and 1,200-mAh packs shown.**

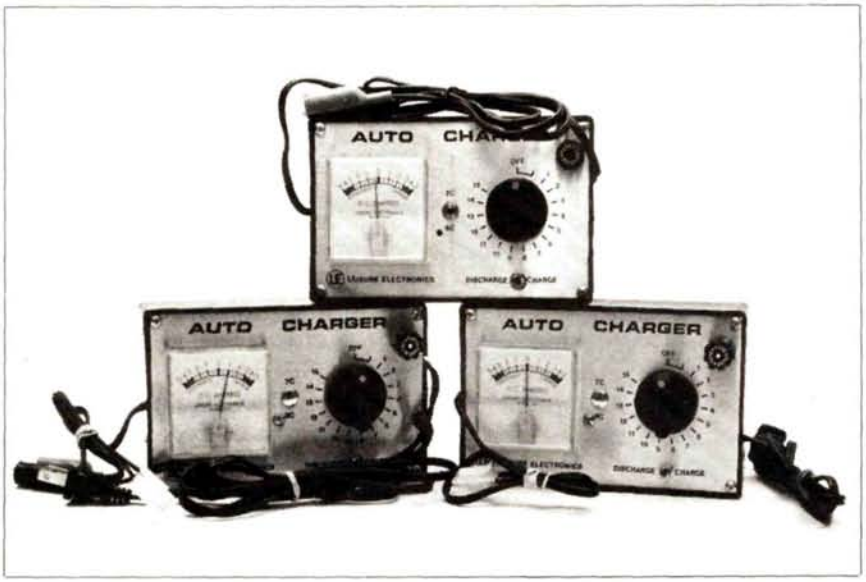
*Overnight Charge:* When charged at the overnight rate, discharged Ni-Cds will usually reach 100% of charge in 14 to 16 hours. This rate is determined by the formula C/10, or the rated capacity of the batteries divided by 10. So, if you're charging 500 milliampere hour (mAh) batteries at the overnight rate, the rate would be 50 mA. For 800-mAh cells it would be 80 mA; 1,200 mAh, 120 mA; etc. This type of charging is the most widely used in R/C. It is also the safest because Ni-Cd batteries can be left on charge at this rate for extended periods (days) without doing any cell damage.

*Quick Charge:* Discharged batteries charged at the quick rate will reach full charge in approximately 4 to 6 hours. This is determined by the formula C/3 or the capacity divided by 3. For 600-mAh batteries, it would be 200 mA; for 900-mAh batteries, it would be 300 mA; 1,200 mAh, 400 mA; etc. It isn't recommended that the batteries be left on charge beyond the 6-hour period or overcharge could result with consequent cell damage.

*Fast Charge:* A fast rate charger will


**Ace R/C 500 heavy-duty battery charger for various applications.**


**Astro Flight fast chargers shown left to right: #100 and #101. Not shown, #102.**




photos by SUE KENNEY

**New fast chargers from Leisure. Models left to right are 107, 104, and 106.**

charge Ni-Cds in 15 minutes or less. It's determined by the formula 3C or three times the capacity. For 500-mAh batteries, this would be 1,500 mA or 1.5 amps. Note: this isn't recommended for R/C receiver or transmitter batteries because the charge time is very critical to prevent overcharge and damage. Only specialized chargers designed for fast charging should be used to fast charge batteries such as those used for electric-powered aircraft, boats, or cars.

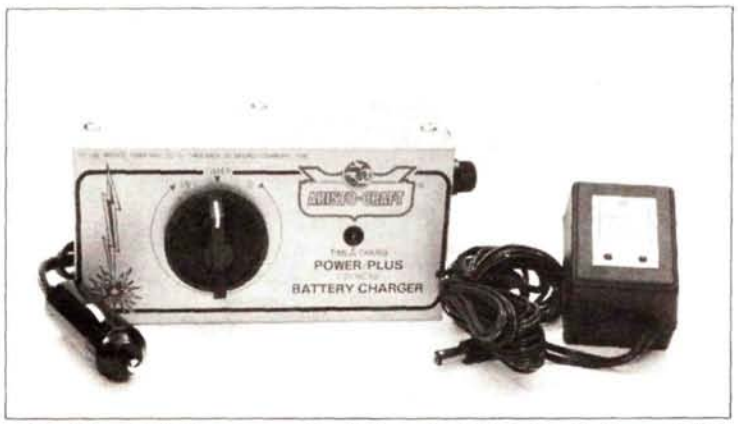
*Trickle Charge:* The trickle (or float) rate replaces the energy that Ni-Cds lose by just sitting around. It's defined by C/50 (capacity divided by 50); for 500-mAh batteries, it would be 10 mA; for 1,200 mAh, 24 mA. Ni-Cds can be left on trickle charge indefinitely without damage and always be 100% charged. Realize, please, that the batteries can't be charged up at this rate, only maintained. If you use the trickle rate, only do so after the batteries have been fully charged, preferably at the overnight rate.

By and large, the best way to charge batteries is overnight, but many times, for multiple flights, fast charges are required at the flying field. Because a new family of chargers has been developed for that very purpose, let's discuss some of them by manufacturer and start alphabetically.

**Ace R/C*.** Ace has recently come out with the H/D-500. I'm sure the "H/D" stands for Heavy Duty and "500" is 500 mA for the maximum charging rate. This is a heavy-duty charger, capable of producing up to 500 milliamps of current at up to 14.4V DC. The output is variable and stays constant throughout the charge period. It's monitored accurately by a front panel meter. Capable of charging a single 100-mAh cell or up to twelve 5,000-mAh cells, it's quite versatile. It can charge up to D-size Ni-Cds for starting or 12V starter batteries, or Gel cells. The unit is small, measuring 5x3½x2½ inches and weighing 1.5 pounds. Its input is 110V 60-cycle AC and it's considered a bench charger unless you have AC power at your flying field. I built the Ace kit and can recommend it.

**Aristo-Craft*.** Two Aristo-Craft chargers were provided for evaluation. The first unit is designed to fast-charge a 7.2V pack. Input 12V power is provided via a car cigarette lighter plug and DC output via a molex connector. A basic charger, it's quite inexpensive.

The second unit is a typical overnight 50 mA charger for transmitter and re-




**Left: Aristo-Craft fast charger for 7.2V packs. Right: Standard overnight charger for 4.8V receiver and 9.6V transmitter packs.**


**Robbe Automax 8 has five voltage and five current ranges available. Charges to 4,000-mAh max.**

ceiver 9.6V and 4.8V DC volts for the transmitter and receiver, respectively.

**Astro Flight*.** Astro Flight has recently come out with three new chargers identified as #100, #101, and #102. The #100 is a 6-cell automatic charger with a thermal cut-off sensor. It was designed to fast charge six Ni-Cd cells of 1,200 mA capacity. The unit is solidly built and has a heavy aluminum front panel to which all electrical components are attached. This assembly is encased in a heavy wall plastic enclosure. The unit measures 6⅛x3¾x2½ inches and weighs about 10 ounces. There is a DC cord for bringing 12V electrical power into the unit, one for taking charging current out, and one containing a temperature probe. On the face of the unit there are two status indicators; the amp meter and the pilot light. The functions of these elements are:

DC Input Cord—The DC cord is designed to bring in 12 volts from your automobile battery. Two alligator clips are installed at the end of the cable; one is red, the other black. Always put the red clip into the positive battery terminal and the black clip on the negative battery terminal. The charger will not work if connected backward.

Ni-Cd Charge Cord—The charger is provided with a Ni-Cd charge cord connector that mates with all 6-cell Tamiya Ni-Cd batteries.

Amp Meter—The amp meter indicates the amount of charge current being supplied to your Ni-Cd battery.

Pilot Light—The pilot light comes on when the charger is in the trickle-charge mode. It's off during the fast charge mode.

Thermal Sensor—The thermal sensor is the round disk-shaped object at the end of the short cable. Its function is to measure the battery temperature, to terminate fast charge, and to switch over to slow or trickle charge when the battery starts getting warm as it becomes fully charged. In order to work the thermal sensor, it must be held tightly against the Ni-Cd battery being charged. Use two rubber bands to make sure you have a good contact, and place the thermal sensor near the center of the Ni-Cd battery. Caution: Failure to attach the thermal sensor to your Ni-Cd battery will result in an overcharge to destruction.

The Astro Flight Model #101 is similar to the #100 in size and function. The most significant difference is that the #101 will charge from either 12V DC or 110V 60 AC power. It's somewhat heavier due to the step-down transformer and rectifier circuitry. The #101 weighs just under 2.5 pounds. The #101 also employs a lamp fuse in the AC input line.

The #102 AC/DC Super Charger can fast charge 1- to 28-cell Ni-Cd packs in 15 minutes from an automobile battery. The charge current is adjustable up to 5 amps. Charge currents are shown as 1.25a for 250-mAh batteries, 2.25a for 500 mAh, 3.25 for 800 mAh, and 4.5a for 1,200 mAh batteries. The unit measures 6¾x5¼x3 inches and weighs just over 1 pound. Astro Flight has three very capable chargers.

**Kyosho*.** The Kyosho auto charger is a versatile unit that will charge any Ni-Cd battery from 4.8 to 8.4V with 100-4,000 mAh capacity. It has an adjustable output current so it can be used for quick

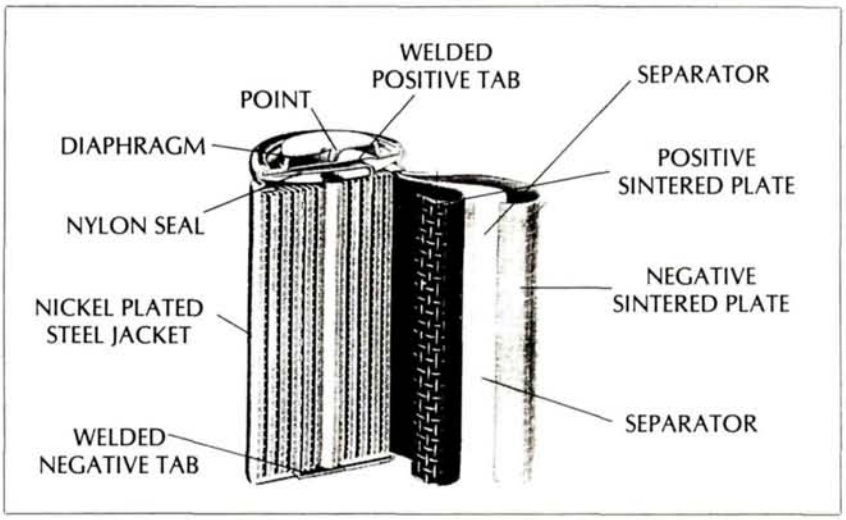
*(Continued on page 81)*

## CHARGER SUMMARY

| Company | Model No. | Input | Output | Auto Trickle Charge | Size | Weight | Remarks |
|---|---|---|---|---|---|---|---|
| Ace R/C | H/D-500 | AC | DC | No | 5x3½x2½ in. | 1.5 lb | Variable output, very versatile |
| Astro Flight | #100 | 12V DC | DC | Yes | 6x3¾x2½ in. | 100 oz | Thermal sensor—6-cell fast charger |
| Astro Flight | #101 | AC/DC | DC | Yes | 6x3¾x2½ in. | 2.5 lb | Thermal sensor—6-cell fast charger |
| Astro Flight | #102 | 12V DC | DC | Yes | 6¾x5¼x3 in. | 1 lb | 1- to 28-cell fast charger |
| Aristocraft | Power/Plus | AC | DC | No | 1⅝x2⅛x2¼ in. | 6 oz | 6-cell fast charger |
| Aristocraft | Power/Plus | | | No | 5⅝x2¾x2 in. | 15 oz | Overnight transmitter/ receiver charger |
| Kyosho | Auto Charger | 12V DC | DC | No | | | Built-in ammeter and voltmeter—auto shut-off |
| Leisure | 104 | 12V DC | DC | Yes | 6⅝x4⅛x2¾ in. | 1 lb | 6- to 7-cell fast charger |
| Leisure | 105 | 12V DC | DC | Yes | 6⅝x4⅛x2¾ in. | 1 lb | 6- to 7-cell fast charger |
| Leisure | 106 | AC | DC | Yes | 6⅝x4⅛x2¾ in. | 2.25 lb | 6- to 7-cell fast charger |
| Leisure | 107 | AC/DC | DC | Yes | 6⅝x4⅛x2¾ in. | 2.25 lb | 6- to 7-cell fast charger |
| Pro-Tech | 701 | AC/DC | DC | Yes | 6x5x2¾ in. | 2 lb | 4- to 8-cell fast charger |
| Pro-Tech | 702 | AC/DC | DC | Yes | 6x5x2¾ in. | 2 lb | 6- to 7-cell fast charger |
| Pro-Tech | 703 | DC | DC | Yes | 6x5x2¾ in. | 12 oz | 6- to 7-cell fast charger |
| Robbe | Max 8 | DC | DC | Yes | 7⅛x3⅜x5 in. | 1.25 lb | 1- to 21-cell fast charger |

# Batteries

by MIKE LEE




SILENT ELECTRIC FLYING has truly come of age. With the advent of high technology construction and engineering, successful electric model aircraft for the sport enthusiast are now easily attained.

What new technology has brought us is plenty: lighter and stronger airframes, more powerful and reliable motors, and, best of all, rechargeable batteries! Can you imagine what electric flight would be like with everything going for it except a dependable and economical power source? Most of us would resort to rubber power or quit trying. But because of our power needs, the key to electric power is the rechargeable nickel-cadmium battery.

In this article, I'll explain some of the mysteries of the nickel-cadmium cell. A good understanding of your power source can not only keep you from making costly mistakes, but can also help make electric flying as easy as walking down the street. Take a tour of the electric flight line and see what a little power can do for you.

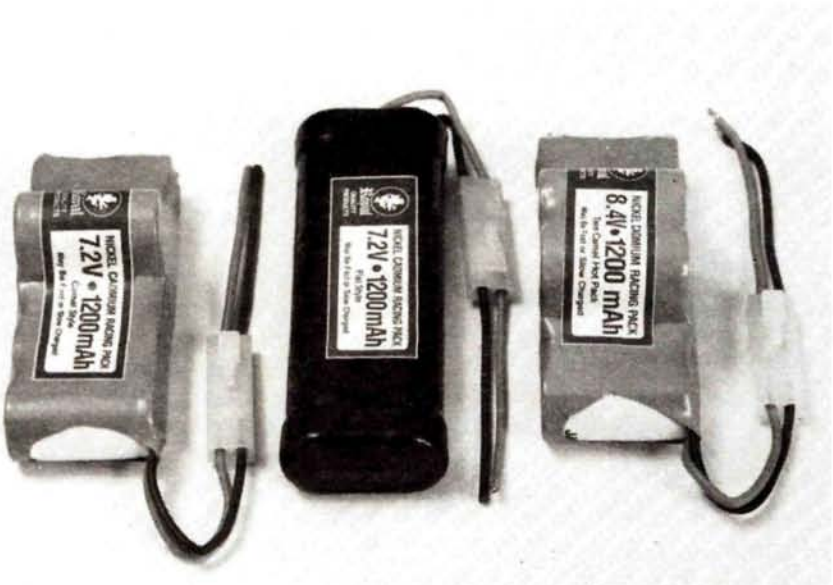
Let's start off with the nickel-cadmium battery. The battery, or cell, is composed of small plates of a nickel and cadmium alloy surrounded by acid, or electrolyte. The reaction of the electrolyte on the nickel and cadmium alloy plates causes a reaction which produces electricity. Fortunately, this process can also be reversed and the result allows us to store or discharge electricity.

All of us use a group of batteries wired together to form a battery pack. The packing of batteries allows us to either gain the sum of all the individual battery cells' voltages, or all of the cells' amperages. We are concerned mostly with the voltages; therefore, we want to wire the pack together in a series arrangement.

Series arrangement of the batteries means that each cell is connected to the next cell from the positive post of one battery to the negative post of the next. Simple, huh? If you connect all the negative poles and all the positive poles, you'll end up with a parallel connection, which results in the amperage of the cells being combined. That makes for one powerful pack, but little voltage. So much on basic electricity, now on to making your own pack.

Making your own battery pack is really easy and economical. The tools you'll need are a soldering iron, silicon wire, heat-shrink tubing, a connector to fit your system, and of course the batteries. I'll concentrate on a basic six-cell battery pack as most 05/075 sport planes use this pack. For batteries I'll use the common Sub-C cell, which has a capacity of 1,200 milliamperes and can be found at most hobby shops.

For the purpose of sport electric flying, you must make sure that your batteries are rated for fast charge operation. Most




**Royal's line of batteries are adaptable to cars and airplanes.**

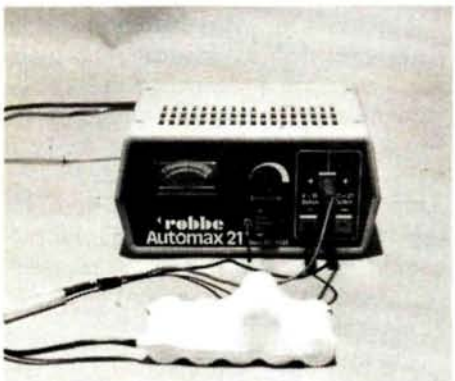
batteries are labeled as fast charge capable, and you should make it a point to read the label before buying. A non-fast charge rated cell will not tolerate being fast charged more than a couple of times before failing. And, believe me, this type of failure can be dangerous. Read the label and make sure you have only fast charge rated cells. By the way, most of these batteries also feature solder tabs, and I'll assume these type of cells are now in your possession.

Construction of the pack begins with a good, hot soldering iron of about 40 watts or better. The pencil type soldering iron is preferred over the gun type because the pencil type will retain tip heat longer. With the iron hot, begin by tinning the solder tabs of each battery. Tinning means to coat the surface of the solder joint with solder before joining them. Use a minimum of time to tin each tab as heat can damage the cell.

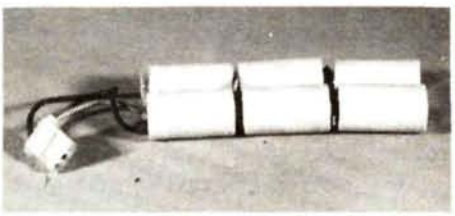
Now, with the solder tabs tinned, begin fitting the cells together. We'll be making a twin-stick pack, consisting of three cells placed end to end, done twice, to make two sticks of batteries.

As you fit each battery together, place each cell side by side with solder tabs overlapping each other. Make sure that you have the positive pole of one battery going to the negative pole of the next. When you're satisfied with the fit, make the solder joint on the tabs with the iron. The joint should be clean and swift. Allow to cool and then bend the batteries over each other, one on top of the other. No sweat, this is all there is to it. Now, by soldering yet one more cell to the first two, you have the first of two sticks. Repeat this procedure to form another three-cell stick and then read on.

Now that you have two sticks of three cells each, you need to join them. Just place them side by side and solder the joint, making sure you have positive to negative. The result should be two side-by-side sticks with every cell wired positive to negative except the first and last cell, which are not wired. *Voila,* the pack is made.




**Robbe Automax 21 charger is a very versatile tool for the electric enthusiast.**



**The Graupner packs come assembled and wired. Custom-made packs only require use of a soldering iron and the proper technique.**


**MRC RB-450 charger has digital display.**

Now tape the batteries together in preparation for the heat-shrink tubing. You may use plain tape to do this. Simply tape the cells together in the sticks, so that each positive to negative joint is tightly joined. Your two sticks should be rigid at this time.

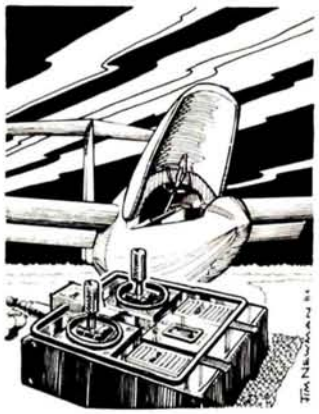
It's time to place the heat-shrink onto the pack. This is the fun part. Slip the battery pack into the tubing and hold the whole thing close to a heat source, such as a stove top. Use little heat, as too much will quickly melt the tubing. The tubing should be shrunk down evenly until it's stretched tightly over the entire pack. Your pack is now ready for soldering the connector to the ends. This is no more difficult than when you performed the pack construction. Simply solder the wires to the solder tabs of the end cells. Make sure that the red wire goes to the positive and the black wire to the negative. Your pack is now ready for use.

Of course, the above pack construction pertains to a twin-stick six-cell pack. Any other pack configuration can be made by using the same technique of positive to negative and heat shrinking. And any number of cells can be used in this arrangement to provide additional voltage to satisfy your power requirement.

A rather disquieting characteristic of nickel-cadmium batteries is their ability to remember. They remember the charge and discharge times. Simply put, a battery which has been charged at the same rate for the same time and then discharged at the same rate for the same time over a significant period of time will remember that cycle. The unfortunate thing about this is that the moment you attempt to get more power from the pack, it might not be there. The battery remembered the previous charging cycles and decided to drop any amount of power excess to those previous cycles. Now, the batteries hold less power.

The way to eliminate this memory is simple. It's called deep discharging and the easiest way to do this is to run the motor until it quits completely. An alternative is to discharge the battery on the battery discharger. Most have dis-

*(Continued on page 91)*



# Soaring News

by JIM GRAY

EVERY ONCE IN A WHILE, I'm reminded that writing and editing must be a little bit like fishing; you throw out the hook and the bait and wait. Suddenly, something comes along and takes the hook and bait and runs with it, and you really don't know what it is until you reel it in and have a look. It's somewhat like that with "Soaring News": the material I present is the bait and hook, and your responses are the fish that I pull into my "boat." It's always interesting, never dull, and sometimes very surprising. Very seldom do I have a "throw back"; most of the "fish" are keepers. If it weren't for you readers and your magnificent letters, drawings, and photos, I don't know what I'd do.

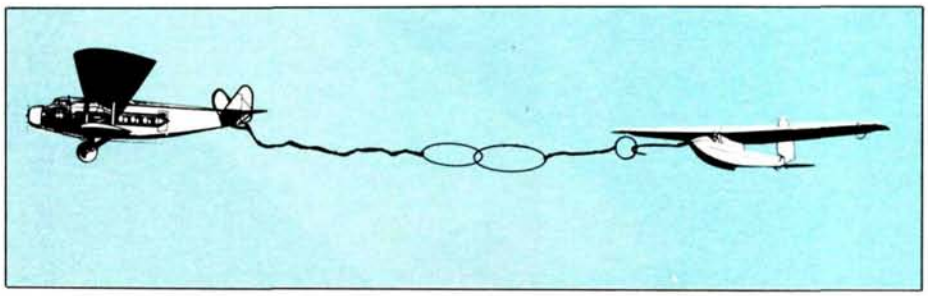
Let me give you an example. A few months ago, I presented a column that concentrated on aero towing. The feedback was tremendous and I've received a lot of information from readers. I guess many modelers are interested in this type of launching, probably because it is not yet common in the U.S. It also provides a means for power fliers to get together legitimately with soaring pilots at the same field and at the same time.

Here is a letter from Ray Stark*, of Abilene, Texas, who has a lot of experience in aero towing R/C sailplanes, and gives some valuable insights:

"In response to your request for information on sailplane towing, I offer the following:

"While stationed at Mather AFB, California, flying T-43 navigator trainers, I met a student navigator who was also interested in R/C. We shared a common love for both powered and unpowered planes. One day at the local field, just as we were about to pack it in, I had an idea: why not try to tow my Gentle Lady up behind my friend Bert Garrison's .20-size Eaglet? Bert had modified it with huge barn-door flaps, and it would fly at a walking pace in a light breeze.

"Earlier that year we had flown every sort of winged craft with huge lengths of colored streamers tied around the tail. This seemed an acceptable solution for the powered end of the string, but for the glider I wanted a sure-fire quick-release system so I could cut away if things got sticky. (As a kid I used to crew for my dad's full-size Ka-6 sailplane.)



**Ray Stark's original towline setup uses rubber bands, a ring, and a hook. Not very complicated.**

"I found a section of rod in my flight kit and screwed the threaded end directly into the nose of the glider. The rod was then bent down at a 150° angle, the idea being that, if I needed to cut away, a swift pitch-up would allow the hook to come off the tow ring. To take up the additional slack and keep the ring from falling out, I installed three or four rubber bands in the towline. Mind you, this was a totally unannounced adventure. With a well-stocked junk drawer in my field box we were ready in ten minutes.

"As with all my Gentle Ladies, I had installed a simple wheel in the belly floor to keep my hooks from grinding on the pavement. With this in mind, we opted for the scale launching method of running the wing until flying speed. After a few false starts, Bert crammed in the power and we were off! The drag of a rolling glider was a bit much for the O.S. .20, but I found that by getting the glider airborne and then flying 6 to 10 inches off the ground, the Eaglet was able to stagger off the runway.

"At slow speeds, the Eaglet will turn on a dime; not the best thing if you're towing someone. Trying to fly directly behind him, I would occasionally overshoot a turn and slack would disappear, yanking the nose over 45° or so with an almost instantaneous airspeed increase. Small gliders really get touchy on the rudder with high airspeed! Wide, gentle, turns were found to be acceptable.

**Tom Gridley launches Mark Altman's Two Tee sailplane from Gros Ventre Butte, Jackson Hole, Wyoming.**

"As the day grew warmer, we found the O.S. maxing out at about 100 feet. On the last flight I got sideways on the towline following the first turn after takeoff. When the line tightened, it took so much energy out of the tow ship that it entered a mushy stall. My glider was literally hanging about 10 feet below the tow ship at about a 30° nose-up attitude. The Eaglet was still controllable, but hopelessly behind the power curve, with

*(Continued on page 108)*

# Basics of Electrics

by DAN SANTICH

IT MAY not be obvious to some, but the future of the hobby of radio-controlled model airplanes depends, to a large degree, on our ability to develop and adapt to electric flight. Lost flying sites due to noise complaints are a major factor, but they're not the only one. Noise creates uninvited attention and is sometimes used as a springboard for legal banishment for such reasons as safety, specific zoning ordinances, or similar non-direct tactics. The bottom line is that without the noise, the attention would probably have never been garnered in the first place.

Aviation history tells us that electric flight preceded gasoline-engine-powered flight by 4 years (in 1844 the dirigible La France flew). Electric-powered models are not new. The idea is over 15 years old, and a U.S Patent (#3957230) was issued to Roland and Robert Boucher in 1976. This was a continuation of their patent application filed in 1973, but their experiments and successes were documented much before that. With their innovations and subsequent products to enable the average modeler to enjoy the realm of electric flight, the Boucher brothers have given us all the ability to venture into it with the prospect of success at a reasonable price.

Any modeler who has experience in building and flying gas-powered models should have no trouble adjusting to electrics. However, where the aspect of building and flying a model remains the same, new techniques and thinking must be adopted. With electric power the weight and wing loading of our models become our primary concern and are the number one reason for success or failure. The concept begins with a given electric unit. A prop, an electric motor, and a battery make up the power unit.

The purpose of this article is to give you an idea of how to cope with electrics on a very basic level. The foundation you build now will determine your progress or failure in electric flight. There is nothing difficult about electrics, and nearly every aspect of modeling has proven to be adaptable to electric power. FAI rules governing electric-powered models are in the AMA Rule Book and you should familiarize yourself with them. In addition, an organization has been formed which deals exclusively with electric flight, the Electric Aeromodeling Association, P.O. Box 9, Midway City, CA 92655.

This organization publishes a newsletter full of information about everything associated with electric flight, and includes articles on batteries, motors,

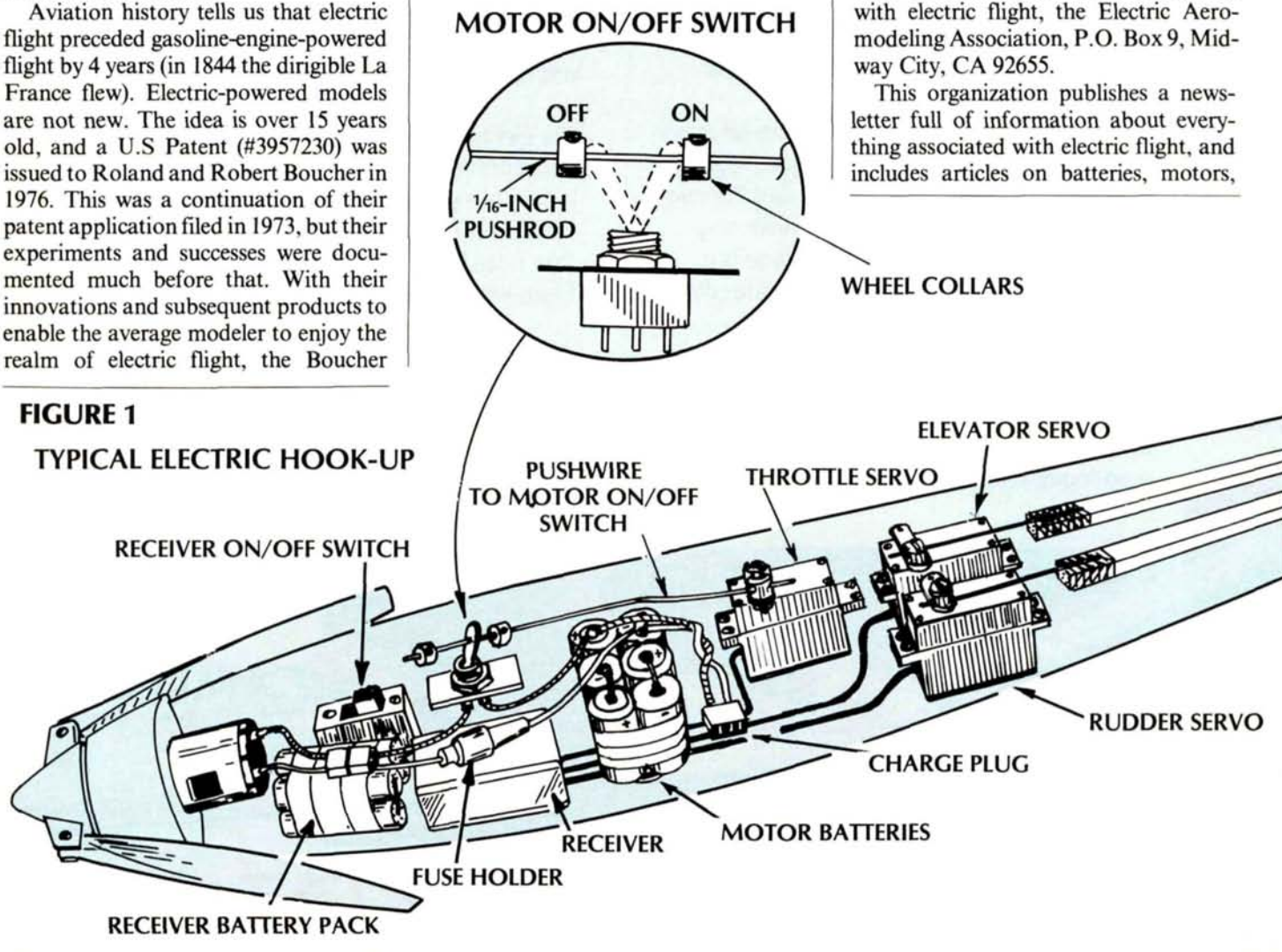
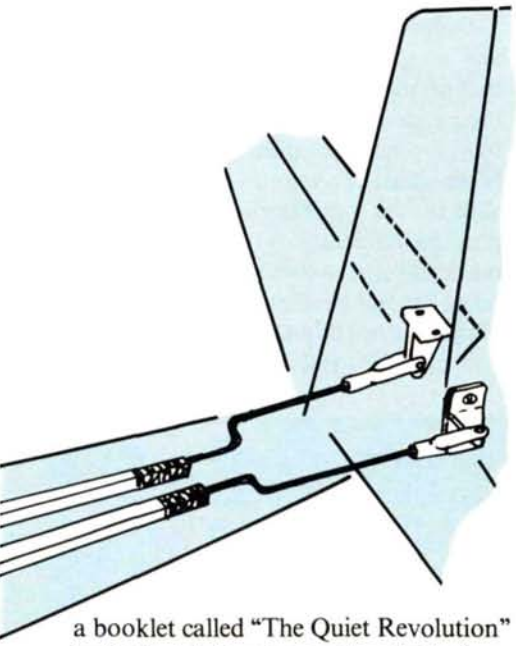



**FIGURE 1**
**TYPICAL ELECTRIC HOOK-UP**

designs, propellers, etc. In addition, information concerning electric flight is covered each month in most of the major model publications. In *Model Airplane News* it's "What's Up With Electrics" by Bob Sliff. Before venturing into electric flight I urge you to learn as much as you can about it. Talk to modelers who are deeply involved in electrics, and observe as often as you can the activities of modelers participating in electric competition. Most times these modelers have been through it a few times over and can help you overcome the pitfalls. (There is



a booklet called "The Quiet Revolution" by Robert J. Boucher and available from Astro Flight* that goes a long way toward covering the aspects of electric flight.)

As with most things, with electrics you get what you pay for. Don't expect to spend $25 for a motor and battery and fly your 8-pound plane the way you would a pattern ship. That simply doesn't happen. High performance, such as that associated with a pattern plane, means spending money. It can be done, however, since the technology is here and the products are available.

One of the most prevalent forms of electric flight is the "schoolyard electric." This type of model is typically lightweight, hand-launched, and relatively inexpensive. Ready-to-fly models are available from Kyosho, Cox, and others that fill this category. Most are supplied with the electric motor and some provide the batteries and chargers. These models fly well if the proper conditions are observed, such as avoiding flying in high winds. The Kyosho Etude has been proven to be an excellent choice for first-time adventures in electric flight, and it will give you some insight into the operation and management, as well as the limitations of electrics.

You'll probably find out, as I did, that electrics are a new challenge. Different techniques and thinking, when compared to gas-powered models, are necessary. The best thing is that you can throw away your glow fuel and rags!

One of the greatest aspects of electric flight is the near absence of vibration. You can build a model much lighter, with less "beef" and less money than you would spend on a gas-powered version. Some current kits which were designed for gas engines are directly convertible to electric power. For the most part these kits are the built-up style rather than the fiberglass fuselage/foam wing types. Some of the Sig kits, such as the Cub, Scamp, Super Sport, and Colt would probably be directly convertible, as would many others. The bottom line is structure, strength, weight, and wing area. These ingredients must then be matched to the proper motor and battery combination.

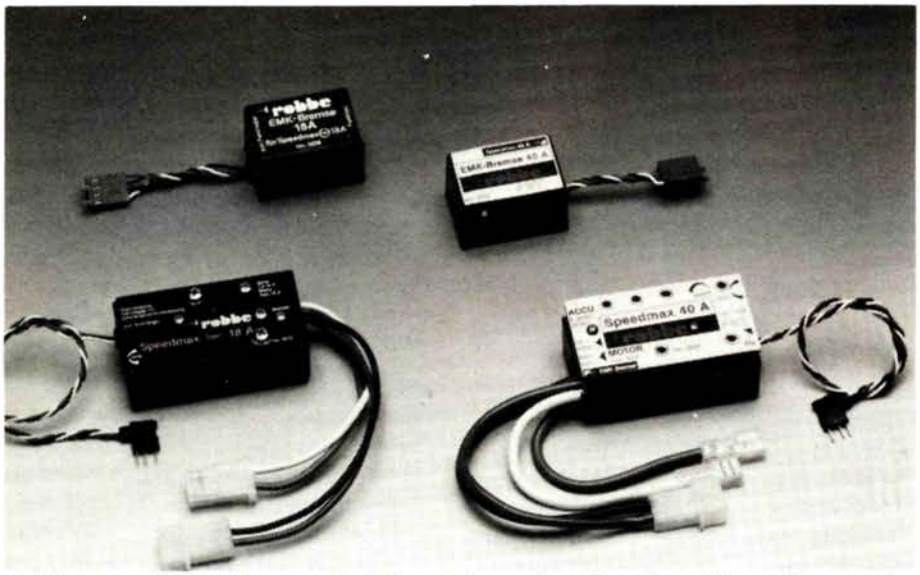
What is the formula for such an arrangement? Good question. The key element is lift, which is even more critical in electric models due to their increased weight over equivalent sized gas-powered models. Of course the weight increase comes primarily from the batteries and the number used. Generally speaking, adding batteries adds performance, up to a certain point. Sometimes the trade-off between the additional weight versus the power gained is not equal, or beneficial, depending on the design of course. As an example, a high-drag design with a lot of lift, such as the Hots, needs more power to achieve the same flight performance as the Etude. Wing loading and airfoil characteristics play a very significant role here.

Speaking of the Hots, I attempted an electric conversion of this Midwest kit. The first idea I had was to place the least expensive electric setup I could find in a basic Hots frame. The result was a slow taxi at best. Since this design flies up a storm on a hot .15 glow engine, I was a bit disappointed, especially considering the fact that with the addition of the electric system I nearly doubled the flying weight. I then went to a higher-quality geared motor, a 14.75-inch folding prop, and a 7-cell, 8.4-volt, 1,200-Ah Ni-Cd pack. The result was a circling flight with limited climb capability. I added two more battery cells to the system and got a climb, if it was accomplished into the wind.

I was learning that there is more to electrics than I had thought. Primarily, I had a wing loading problem, but I was also confused over the proper motor/prop setup.

If we have a handle on the kind of aircraft we want to fly, as well as the desired performance, we should be able to decide on an electric setup that will do the job. Here again we have a bit of a problem since the electric motors are not rated the same way as model airplane engines, i.e., cubic inch displacement. The formula for determining the displacement of an electric motor is displacement equals rotor diameter squared times length times 3.14 divided by 4.

Also how do you know how many batteries to use and what effect does




**Robbe's speed controllers come in different sizes and configurations. Shown above are the Speedmax 40, Feedback brake 40 A, Speedmax 18A, and Feedback brake 18A.**

gearing have on performance? Is an electronic speed control (throttle) needed? What kind of prop do you use and how do you match the prop to the motor? Or do you match the prop to the design of the airplane? How do you wire these things up, what type of wire do you use, how do you know which direction the prop will turn, where do you fuse the wiring, and is cooling of the motor and batteries necessary? Another big question is how do you charge these batteries, especially when you have as many as 20 cells in one airplane? The last question I have is that when I learn all of this stuff do I qualify as a bona fide electronical/mechanical engineer?

Bob Boucher of Astro Flight has worked up some figures that he calls "rules of thumb for successful electric flight":

**Kyosho geared power unit from Great Planes Model Distributors is used in several electrics, including the Etude.**


1. The model airframe and radio should weigh no more than the motor and battery combination, and preferably less.

2. The wing loading must not exceed the maximum recommended for the purpose intended, as Chart 1 explains.

Fortunately, Astro Flight does sell complete systems, ready to install in your airplane. Their concept is to provide everything wired and checked out so the modeler doesn't have to hunt and fiddle with different batteries, switches, wiring, etc., to have success.

Unfortunately, there don't seem to be any figures or power charts available that list the different electric motors as to their equivalent performance compared to a glow engine. I think there should be. Most modelers venturing into electrics gained their experience in glow-engine-powered modeling and they simply don't relate to watts as a measure of performance. But this problem is one that has all of the electric enthusiasts, manufacturers and modelers included, in a tizzy. The

## CHART 2

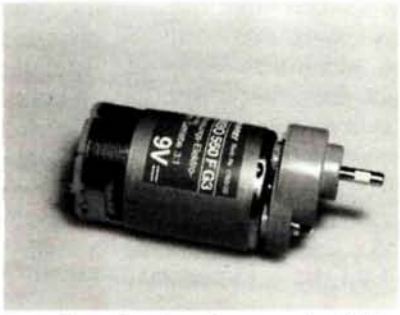
| Brand | No. or Size | Type | Bearings | # Poles (Brushes) | Type Brushes | Weight | Dimensions (Dia. & Length) |
|---|---|---|---|---|---|---|---|
| Astro | 40 | Cobalt | Ball | 2 | Silver | 13 oz | 1⅝x3 in. |
| Astro | 25 | Cobalt | Ball | 2 | Silver | 11 oz | 1⅝x2½ in. |
| Astro | 15 | Cobalt | Ball | 2 | Silver | 7.5 oz | 1 5/16x2¼ in. |
| Astro | 05 | Cobalt | Ball | 2 | Silver | 6 oz | 1¼x2¼ in. |
| Leisure | 502 | Ferrite | Bronze | 3 | Copper | 5.5 oz | 1⅜x2 in. |
| Leisure | 503A | Ferrite | Bronze | 3 | Copper | 6 oz | 1⅜x2 in. |
| Leisure | 601 | Ferrite | Ball | 3 | Copper | 6 oz | 1⅜x2 in. |
| Leisure | 603A | Ferrite | Ball | 3 | Copper | 6.5 oz | 1 7/16x2⅛ in. |
| Robbe | Elt-Max 50/14 SE | Cobalt | Ball | 2 | Carbon | 11.5 oz | 1⅜x3 1/3 in. |
| Robbe | Elt-Max 50/20 SE | Cobalt | Ball | 2 | Carbon | 11.5 oz | 1⅜x3 1/3 in. |
| Robbe | Starmax 40 | Cobalt | Ball | 2 | Carbon | 8.1 oz | 1¾x3 1/3 in. |
| Robbe | Starmax 48 | Cobalt | Ball | 2 | Carbon | 11.5 oz | 1.9x3 in. |

## CHART 1

| Type Model | Purpose | Minimum Wing Loading | Maximum Wing Loading |
|---|---|---|---|
| Sailplane | Soaring | 8 ounces per square foot | 12 ounces per square foot |
| Old Timer | Thermal Soaring | 8 ounces per square foot | 12 ounces per square foot |
| Sport | Mild Aerobatics | 16 ounces per square foot | 18 ounces per square foot |
| Pattern | FAI Aerobatics | 18 ounces per square foot | 24 ounces per square foot |
| Scale | Scale Flight | 18 ounces per square foot | 24 ounces per square foot |
| Pylon | Racing | 20 ounces per square foot | 24 ounces per square foot |

**The Astro Cobalt 40 weighs 13 ounces and will turn a 10x5 prop at 12,000 rpm on direct drive.**

**Robbe's Elt-Max Cobalt motors have ball bearings and are high-quality.**



**Deep into electrics, Graupner (available in the U.S. through Hobby Lobby) provides many variations of motor/geared arrangements.**

reasons are many. For one, there is a controversy over the method of rating the displacement for an electric motor.

Of course the argument to that concept is which glow engine do you use for comparison, a mild-mannered one or a hot, piped engine. In fact, some modelers suggest using ignition engines as a comparative, since their performance was low when matched with modern-day high-powered engines.

I don't intend to solve this problem, nor to offer advice as to how to do it, since I'm hardly qualified. I feel strongly that for the electric movement to really take off, the cloud of mystery that envelopes it should be lifted, and that means giving the modeler more information about the application, as well as the limitations, of electric powerplants.

Electric flight is covered in the AMA Rule Book under FAI event designation F3E. The maximum established weight for an electric-powered model is 11 pounds and the maximum surface area is 2,325 square inches. The wing loading must be between 3.93 and 24.59 ounces per square foot. Maximum voltage is 42 and there is a limit of 30 Ni-Cd cells. These rules apply to electric-powered gliders and aerobatics. Pylon racing has no limit on motors or batteries, but the weight limit is 5.5 pounds.

| Max. Volts | No. of Battery Cells | Max. Amps | Power/Watts | Geared/ Direct Drive | Max. rpm | Equivalent Power | Prop |
|---|---|---|---|---|---|---|---|
| 24 | 18-21 | 35a | Out/500w | Dir/Gear | 12,000 | .40 2-stroke | 10x5 |
| 18 | 14-16 | 35a | Out/375w | Direct | 11,000 | .25-.30 2-stroke | 9x5, 9x6. |
| 15 | 12-14 | 26a | Out/180w | Direct | 16,000 | .15 2-stroke | 7x4 |
| 8 | 6-8 | 26a | Out/120w | Direct | 12,000 | .09 2-stroke | 8x4 |
| 9.3 | 6-7 | 20a | 100 | Direct | 14,500 | | 6x4 |
| 9.3 | 6-7 | 20a | 100 | 2.5:1 | 5,500 | | 11x6 |
| 9.3 | 6-7 | 20a | 100 | Direct | 15,500 | | 6x4 |
| 9.3 | 6-7 | 20a | 100 | 2.5:1 | 6,000 | | 11x6 |
| 12-17 | 16 | 25a | 525w | Direct | | | |
| 21-28 | 16 | 22a | 615w | Direct | | | |
| 9-14 | 7-12 | 16a | 225w | Direct | | | |
| 12-20 | 10-16 | 18a | 290w | Direct | | | |

**Left to right: Kyosho Cardinal, Robbe's Geier E, and Kyosho Etude are examples of electric kits available.**

For the average sport modeler—and that's probably where the real action is—getting into electrics is simply a matter of forgetting everything learned about glow engine models and concentrating on wing loading and available electric power, which takes some very careful thought, particularly with scratch-built models or original designs. For electric kits, most of this has been worked out and it surely applies to ready-to-fly models, such as the Kyosho Etude and the MRC electrics, such as the Cardinal.

To help you get a handle on electric


**Kyosho's Motor Checker is a convenient tool in determining the condition of your motor.**

powerplants, I've prepared Chart 2, which will give you some information concerning a sampling of the different types available. There are many different brands of electric motors that are used; the Keller and Unger motors, for example. Since I could not locate a source of supply or any data for them, the only thing I can tell you is that they are apparently available and are high-quality units. As I stated before, I cannot give you definitive power or comparative figures to glow engines. Astro claims that their geared 25 units put out as much

**Robbe's Windy Motor Glider.**

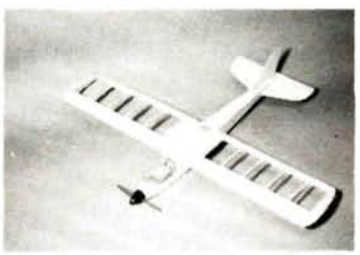
power as a four-stroke .40, and they also claim that the geared 40 unit is on a par with a .60 four-stroke engine. The number of battery cells they used for this comparison was 18 on the 25 and 21 on

**Graupner makes folding props for electrics.**

the geared 40. I cannot verify this claim since I haven't tested the unit. The most powerful motor seems to be the Astro 100. This is a cobalt unit that, on direct drive and 30 cells, turns an 18x6 prop at 10,000 rpm. By the way, a 1,200-mA battery weighs 1.85 ounces, so 30 of them means 3½ pounds of batteries, which is not too bad when you consider the kind of airplane you could put this setup in. In fact, the overall weight is less than a Kavan FK-50, yet has more power than the big twin.

The electric motor must have a prop on the front, and here again there's a wide area of consternation. There seems to be no formula for a happy match between motor, aircraft design, and prop. It all depends on how many batteries you use with a given motor, plus the factor of shaft speed and the airframe design. It's a common feeling that the geared units are similar in characteristics power-wise to four-stroke engines, meaning that you can turn a larger prop. Obviously you are turning at least half of the rpm, so you should not be misled by the fact that you can turn a 14x6 prop on an 05 unit. If you put it in an airplane with 200 or 300 square inches of area that weighs 4 pounds, obviously you won't get too far or too high.

In general I think it would be safe to



**Hobby Horn's Thermic Traveler (top) and Lightning (bottom) show wide differences in design parameters for electrics.**

say that with a geared unit you want more blade surface area to take advantage of the slower rpm. The direct drive motors turn as much as 16,000 rpm, so you would use smaller, thinner blade props. But, as I said earlier, there seems to be no real evidence that a particular prop size works best on a given setup, unless of course it's a ready-to-fly system. Mind you, although these electrics run quiet and are nearly vibration-free, that spinning prop can still cut you badly, so take care. Also, the rpm buildup is nearly instantaneous, so make sure you're hanging on tightly.

*(Continued on page 81)*

**FIGURE 2**

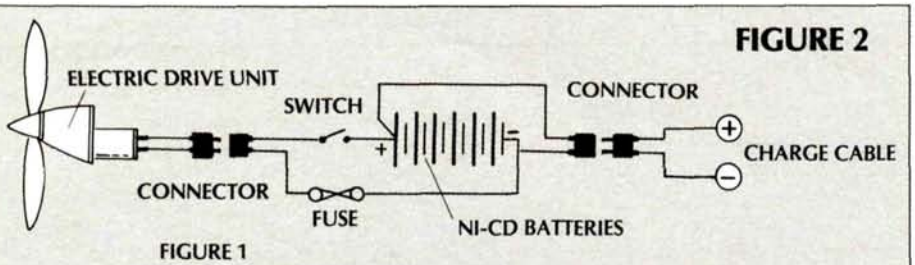



FIGURE 1
AIRBORNE ELECTRIC SCHEMATIC

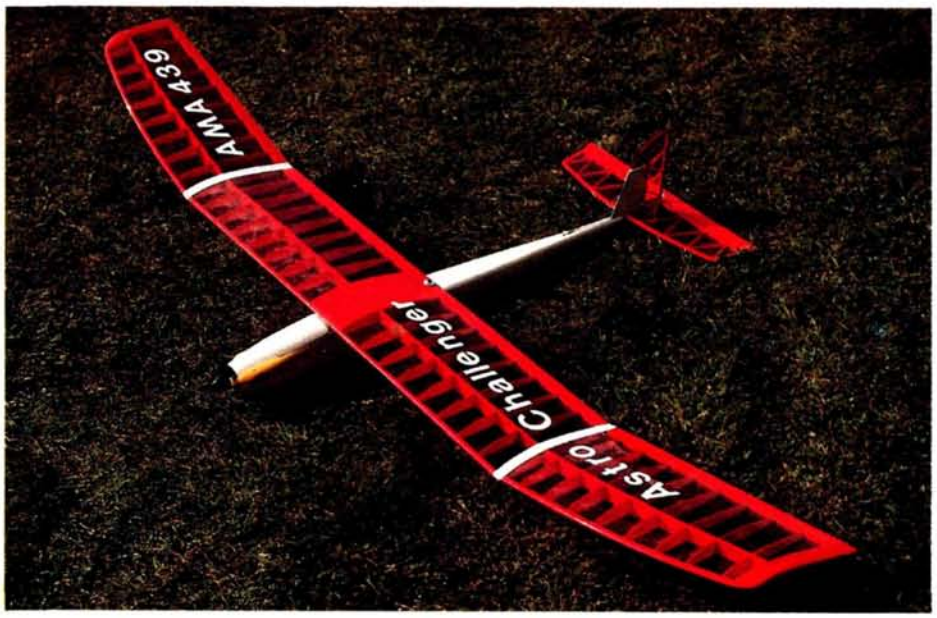
# Electric Kit Summary

HERE IS A selection of electric ARF and balsa kits. Obviously we don't have space for all the great kits available today for electric, but one of these is bound to lure an avid sport-flier.

## Astro Challenger

***Type:*** *Electric Sport and Competition*
***Span:*** *70 inches*
***Area:*** *630 square inches*
***Channels:*** *3*

by BOB BOUCHER




I BEGAN designing the Challenger right after our tenth annual Astro Championships in February 1984. At that contest Mike Regan amazed everybody with the fantastic climb of his electric Mirage sailplane. Mike used the new Astro* Challenger Cobalt geared motor with seven Sanyo 800-mAh Ni-Cds. I figured that with a model designed especially for the geared motor, I would have an unbeatable combination.

Using my IBM computer program I tried various combinations of wing area, wingspan, and airfoil sections. For these calculations I assumed that the model would weigh 38 ounces complete with motor, battery, and radio. The actual model weighed 39 ounces. The computer said that the model with the best still air time after a one-minute motor run would have an Eppler 193 airfoil, a span of 6 feet, and a wing chord between 8 and 9 inches.

Using these parameters I began to lay out the model. I wanted to try a flat center section and an open frame wing for minimum weight and minimum work. In order to eliminate the requirement for wash-out to alleviate tip stall, I chose an elliptical planform for the wing tips. I matched this with an elliptical stab for a distinctive and pleasing appearance. This wing/tail combination really works. The glide is superb and the model just won't tip stall. Another bonus of eliminating wash-out is that with the power on, the Challenger will fly inverted and do nice rudder rolls. The Eppler 193 is thick enough so that the MonoKoted wing is torsionally stiff to resist flutter, even in steep descents.

The power train consists of the Astro Cobalt 05

*(Continued on page 100)*

# Davey Systems Miss L.A.

by STEPHEN SCOTTO

***Type:*** *Sport scale* ***Wing Area:*** *340 square inches*
***Wingspan:*** *44 inches* ***Weight:*** *45 ounces*

ELECTRIC power isn't exactly new. While pioneers of electric have experimented for more than a decade, a few brave manufacturers have brought effective systems to market. However, it's no secret that E-power has remained an underutilized and low-profile power source.

Well, it's 1986 and the electric scene is changing faster than I can tell about it. Driven by enormous strides in battery and motor development, electrics are on the verge of becoming an everyday experience at every field. Unfortunately, there has been one element missing from the electric flight system—kits. Sure, there have been a couple, but precious few have been designed with the sport flier in mind. Most of the available designs lack landing gear and the few that have this feature are built around the larger (read more expensive) power systems.

Davey Systems* has answered my objections with the Brown B-2 Miss Los Angeles. Designed around the popular 05-size flight system, this plane performs well with a variety of motor/gear drive/battery combinations. It's a scale ship (my favorite) that's easy to build, very light, and surprisingly strong. It's also a great way to get into electrics without spending too much money on exotic components or super sophisticated chargers.

The full-size Brown B-2 was built in 1934 for one reason—racing. A small airplane, it spanned 19 feet, 3 inches. Dry weight was 882 pounds and nearly half its weight was concentrated in the 300-hp Menasco engine. With Roy Minor at the controls, it took second place in the Thompson trophy race of 1934. It took a couple of first place wins in its engine displacement class. Like too many other racing planes of its era, the Miss L.A. ended in disaster. It crashed early in the 1939 Greve Trophy race, ending the life of its pilot, Lee Williams.

THE KIT. The Davey Systems kit is almost 100% balsa with a few lite-ply bulkheads. The wood is first quality with weight and grain well-matched to their use. Die-cutting is excellent with all cut parts falling out neatly. Don't get careless with the sheet and stick wood; there is enough, but none to waste.

The wing is an open framework built around balsa spars and turbulator strips. The fuselage is 1/16-inch balsa sheet sides strengthened with a lightweight frame. Tailfeathers are 1/8-inch sheet. Fight the temptation to beef-up the structure. It may seem unacceptably fragile during construction, but good design assures plenty of strength in the finished product.

*(Continued on page 112)*

# Kyosho Duet

by KIP KUBA

***Type:*** *Sport twin*
***Wingspan:*** *47 inches*
***Wing Area:*** *375 square inches*
***Channels:*** *2, 3 or 4*
***Weight:*** *46 ounces*


THE LOVE of twins is a multi-faceted affair. Some love a twin for aesthetic reasons, others know that spreading the power between two props is more efficient, and that spells more thrust and forward motion. Some simply love the sound of a twin. Even though the Duet is an electric twin, you can still hear a droning from the props; soft, yet distinctively a twin.

The Kyosho Duet from Great Planes Model Distributors* is basically the same model as the Etude (see *M.A.N.* July '85) with two gear reduction Mabuchi 540s in wing nacelles instead of one in the nose. The wing, fuselage, and tailfeather construction is identical to the Etude; a built-up balsa wing covered with red film and OHS hard-skin fuselage with plywood formers. Total building time for my Duet was two leisurely evenings.

Since the motors are wired parallel to a common battery, each unit puts out the same as one would connected to the same battery. You do pay a price in duration, however. The flights on my model average 4 to 4½ minutes. To me this is still quite acceptable considering the very brisk performance delivered by this electric. Incidentally, my times were clocked at an all-out motor speed. You can get more duration by switching the motors on and off in flight.

THE KIT. The Duet comes very well packaged for protection and all small parts are bagged and contained in a separate box to prevent them from flying around and damaging the nicely finished fuselage and wing. As usual Kyosho gives you an extremely complete set of instructions, leaving virtually nothing to the imagination. Items needed to complete the kit are a two- to four-channel radio, a 7.2V battery, and a charger. Everything else, including epoxy, is in the box.

As I've already said, the Duet is a fast electric. Taking off pavement is a breeze. If you wish to ROG, a four-channel mini radio is preferable to give you rudder control for ground steerability. However, since the Duet is easily hand-launched, three or even two channels are all that are required. You simply put the motor switch on the outside of the fuselage and turn it on manually instead of using a servo.

FLYING. Having flown the Etude I had confidence in its twin counterpart. As it turned out the extra 6½ ounces added by the second motor unit went fairly unnoticed when it came to slow flight. The model has no tendency to snap and has a very predictable rate of descent.

So there's no reason to be leery of a twin any longer. With the Duet you need not concern yourself with one motor-out operation. Your only worry will be running your flight pack battery down in wanting to get one more flight on this fun little twin.

*The following is the address of the company mentioned in this article:*

*Great Planes Model Distributors, P.O. Box 4021, Champaign, IL 61820.* ■

# Kyosho Valencia

by RICH URAVITCH

***Type:*** *Powered glider*
***Wingspan:*** *70 inches*
***Wing Area:*** *470 square inches*
***Weight:*** *3 pounds*
***Channels:*** *2 or 3*


WITH THE number of flying sites being lost due to, among other things, noise, it's becoming increasingly important to find alternate sources of propulsion for our airborne vehicles. The current wave of four-cycle engines with their actually pleasant, and certainly more realistic, sound goes a long way toward "real estate preservation." The phenomenal visibility provided to the hobby in general by R/C cars has provided some interesting and valuable spin-offs; specifically high-performance electric motors, large capacity batteries, quick field chargers, and similar ground-based niceties. The Valencia 1800, manufactured by Kyosho and distributed by Great Planes Model Distributors*, rolls these up into a very attractive airborne package which represents a quickly assembled, nice flying, and extremely quiet electric motor glider.

THE KIT. The kit will take a couple of evenings to assemble, with one of those devoted to radio installation. The fuselage appears to be blow-molded white plastic, not unlike the polypropylene fuel tanks we've known for years. The really neat part is that the two wing panels and the horizontal stab are built-up balsa covered with MonoKote and *they arrive that way!* There's no building or covering. I'd like to hire the guy who does the covering to finish some of my other airplanes, it's that good. The side advantage of the built-up balsa structure is that should you prang it, repairs are conventional. I was most impressed with some of the design niceties included, such as snap-in retainers for the battery pack, a hinged pilot figure, and the use of velcro-type material to facilitate quick battery pack changes. Although I've yet to test the durability of the airplane, it certainly appears to be rugged enough in the right places.

I used three of the four available channels of the Futaba Conquest FP-T4NL in the Valencia, along with the Futaba FP-S20 servos and 225-mAh pack. There is no space problem, I selected these components primarily for a slight weight advantage which really didn't make a huge difference. A conventional flight pack will work just fine.

The instruction manual that came with my kit was in Japanese without English translation. The fact that the illustrations were sufficiently clear to allow me to produce an airplane that looked like the one on the box speaks well for their clarity. Production kits will include the appropriate English instructions.

FLYING. The plug-in wing panels make transport to the field a cinch. Team Ziroli (Nick and Nick Jr.) was on hand to assist in the maiden voyage of the Valencia, so I attached the wings, installed a freshly charged 7.2V pack, turned on the radio, checked the controls, and switched on the motor for a pre-flight check—sure seemed to pull good. Okay, I turned off the motor, handed the whole works to Nick, grabbed a camera, and headed for the runway. The wind was moderate but right down the centerline, so I gave Nick the thumbs up to signal my readiness and he activated the motor. The Valencia accelerated quickly and was airborne in about 75 feet. Climb-out was moderate but positive and Nick proceeded to fly a large right-hand circle for pictures. About 30

*(Continued on page 107)*

# Kyosho Zero

by CHRIS CHIANELLI

***Type:*** *Sport scale*
***Wingspan:*** *40 inches*
***Wing Area:*** *273 inches*
***Channels:*** *2, 3, or 4*


WHEN I saw the Kyosho electric Zero at Toledo, I thought, "Oh boy! The image of electrics may be changing!" Immediately I started to daydream about follow-up kits, an electric Corsair, a Thunderbolt, or maybe even a Focke-Wulf. Then reality struck. Would this little foam Zero fly or not? Well, if it didn't, you can bet your life I would have left it off my list of kits to write about.

THE KIT. The Kyosho Zero, available from Great Planes Model Distributors*, is a hard-skin molded foam kit that comes finished in jungle-green and gray. From start to finish the model took me 3½ hours, including the application of the big red meatballs on the wing and fuselage. Other time-saving features include pre-installed plywood formers and pushrod tubes in the fuselage and pre-installed ailerons and aileron torque rods in the wing. Incidentally, the wing is one piece and does not need joining. You'll also find a pre-hinged elevator and rudder.

The Zero comes with a souped-up ball bearing 240E LeMans already bolted to the reduction unit. A word of caution: while braking in the motor on the bench with two D alkaline dry cells, some of the Allen screws on the reduction unit started to come loose. I recommend using Pacer's Zap Lock on all the screws. I've subsequently done this on all my reduction units since they are subjected to drive gear vibration.

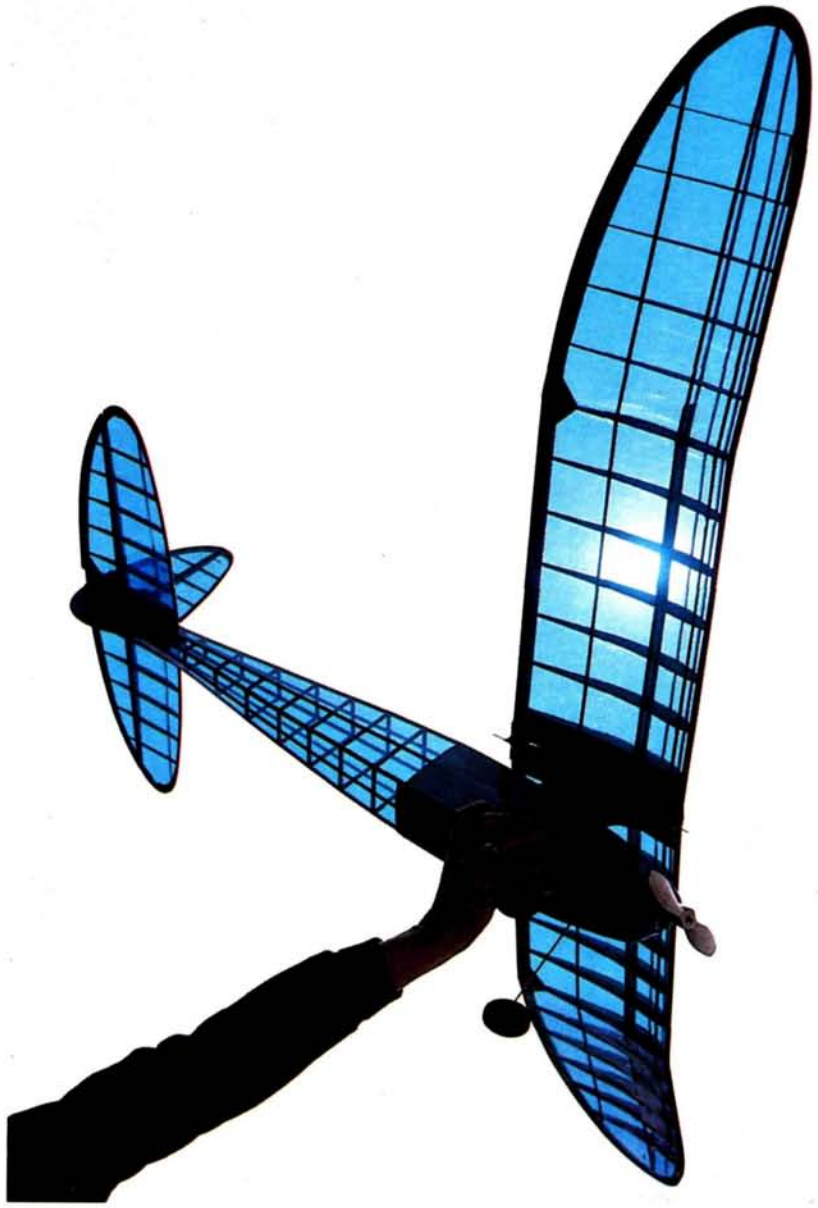
With all the prefabrication and very comprehensive instruction booklet, assembly of the Zero is utterly simple. I completed all major steps while watching *Star Trek*. Of course, having seen all the episodes 500 times each, I don't find it necessary to watch the TV to know what's happening, listening is quite sufficient. Anyway, you get the picture. I

*(Continued on page 92)*

# Leisure Playboy

by ART SCHROEDER

***Type:*** *Old Timer*
***Span:*** *67 inches*
***Area:*** *576 square inches*
***Length:*** *37 inches*
***Weight:*** *35 ounces*



THE LEISURE Electronics* Playboy is something of a "time machine"! The marvelous kit filled a couple of weeks of my spare time with nostalgia and returned me to construction techniques I had all but forgotten.

The Playboy is certainly not an overnight project. There is a lot of building using various size balsa sticks, open frame tail surface, and multi-spar polyhedral wing. Although it requires more effort than a slab-sided trainer, there is nothing beyond the capabilities of most average modelers. And the satisfaction you'll feel when you see that multi-component airframe is one of modeling's great rewards. When finished, you'll fully understand the often-heard remark, "It's too pretty to cover!"

The instructions are quite satisfactory and they take the builder step-by-step through the construction stages. Long-time modelers probably won't need the instructions, but this long-time modeler found them very helpful!

All ready to go, the Playboy weighed in at 36 ounces for a nice under 9-ounce per square foot loading.

With a full charge, the throttle was advanced and that fan really started to hum. A flip of the wrist had the Playboy airborne—it was back to 1940 again, only there was no bark of an Ohlsson 23 to break the mood. In seemingly effortless fashion the Playboy climbed away while I held a touch of back stick. In less than two minutes, the bird was as high as I care to go, so I shut down. The quiet was eerie as I searched for rises on this cold day. I found a few and the Playboy rode them well. I guess my duration was about 12 minutes—I still have much to learn about glider gliding—but I had flown it and it flew well.

Landing was easy, but remember this bird is a floater! Nice thing, if you're too far off the mark, you can always switch power back on for another try.

The Playboy flies so easily, it would make a near ideal trainer for even a rank novice. All one needs to do if they get into trouble is let everything go—the Playboy flies fine on its own. But, for this reason, be sure you name and address are somewhere on this model—it can fly a long way.

While construction takes more time than some trainers, it's all fun and easily accomplished. One factor I had forgotten about well-engineered structures—they can take far more abuse than one would think.

I really enjoyed the project—it was an excellent kit that produced a fine-flying old-timer. Now I'm waiting for one of those lazy summer afternoons to have a relaxing time soaring with the birds. Perhaps you'll come along?

**The following is the address of the company mentioned in this article:*

*Leisure, 11 Deerspring, Irvine, CA 92714.* ■

# MRC Cessna 172

by ART SCHROEDER

***Type:*** *Sport*
***Wingspan:*** *44 inches*
***Wing Area:*** *260 square inches*
***Weight:*** *30 ounces*
***Power:*** *RS-380 Electric*
***Channels:*** *2 to 3*
***Wing Loading:*** *16.6 ounces per square inch*



OVER THE PAST several years, electric power has certainly been proven as a practical power method for model aircraft. Its advantages, particularly a virtual elimination of noise, have been well documented. Indeed, electric powered airplanes can be flown anywhere and you'll never hear a noise complaint since the complainers will never hear any noise. Electric airplanes have had problems with battery weight, charging, and relatively small propellers, but these have been overcome by today's fine power cells, automatic fast rate chargers, and gear boxes.

If you've been avoiding electric power because you simply didn't know how to start, I have a new bird I'd like you to meet—Model Rectifier Corporation's* Cessna 172. The kit, manufactured in Japan by Acoms, contains everything you need (except radio, battery, and charger) for some really fine electric flying; it's simple to assemble and flies great.

The simplicity stems from finely prepared, finished all-foam parts that require no more than epoxying two wing halves together and gluing stabilizer/fin parts in place. Finished trike gear parts plug into place and are retained by a couple of screws. All surfaces are hinged with pushrods prepared to exact length to connect servos to rudder and elevator. The electric motor is supplied (an RS-380 unit that includes the switch harness) and mates to a 1:3 gearbox. The gearbox drives a plastic 9x4 propeller that survived all my tests including a few pretty bad landings. All this, in turn, fits a mount bolted to a plastic firewall with a rubber band—light, practical, and crash resistant. The airplane is decorated with a fine set of vinyl markings that change a colorless white blob into a sparkling airplane.

I won't go into any elaborate exposure of assembly techniques. The instruction booklet covers every possible question. There's no doubt in my mind that anyone—even someone from Mars who has never seen an airplane—could assemble and ready for flight MRC's latest offering. The entire job, including photographs, took a little over 2 hours for me and I'm not noted for speed in anything.

The Skyhawk proved to be very easy to fly and exhibited the maneuvering potential of any typical high wing, rudder/elevator aircraft. In flight, the relatively light loading shows up. The airplane hand launches easily and, at the expense of flight time, easily handles ROG. Loops are very nice and barrel rolls are quite easy to produce. The airplane will

*(Continued on page 92)*

# Robbe Parat TF-1

by VICTOR WENDT

THE FIRST MODEL airplane I built was the TD Coupe from a 1936 issue of *Model Airplane News*, so I was pleased when I was asked to do a *M.A.N.* Field & Bench Review. I was even more pleased when the Robbe* TF 1 Parat arrived.

THE KIT. The kit includes almost all of the items needed to complete the construction and the quality of the materials is excellent. The plans are quite clear, with complete multi-lingual instructions with lots of photos.

***Type:*** *Sport Trainer*
***Wingspan:*** *49.8 inches*
***Wing Area:*** *455 square inches*
***Length:*** *35.5 inches*
***Weight:*** *40 ounces*
***Electric:*** *05*
***Channels:*** *2, 3, or 4*


CONSTRUCTION. The wing is foam with veneer covering. All you have to do is add the leading edges and the wing tips, and join the two halves together. I used white glue for this and reinforced the center section with the glass cloth furnished in the kit. I sanded the leading edges and tips to shape and, with the exception of the covering, the wing was complete. For the electric version, a built-up wing kit is optional.

The fuselage was next and I found that construction was just as straightforward as in the wing. I used Satellite City* Hot Stuff and retarder to speed construction.

Next I glued bulkheads #36 and #35 to each end of the fuselage floor, and I was ready to glue the fuselage sides to the floor. I ensured that all bulkheads were square.

Before I attached the top and bottom covering to the fuselage, I installed the control rods. I chose to use the tube type and this, of course, required that I anchor it at both ends prior to closing in the fuselage. At this point I installed the plywood landing gear blocks into the fuselage. I used 5-minute epoxy to ensure a secure mount that would handle the stress that is placed on the landing gear. I attached the landing gear itself after the aircraft was covered and I attached it with nylon straps and screws.

Having accomplished this, I added the balsa blocks to the nose area and sanded and shaped the entire fuselage to conform with the plans.

The tail surfaces (rudder, elevator, and stabilizer) are constructed from balsa sheets the same as most R/C model planes, so enough said about this.

I covered the model with white Top Flite* Super MonoKote. I offset the red trim with black 1/16-inch trim.

FLYING. The TF 1 was ready for testing so off I went to the flying field.

This model is a winner for the newcomer to R/C. It's a stable but responsive trainer.

**The following are the addresses of the companies mentioned in this article:*

*Robbe, 180 Township Line Rd., Belle Mead, NJ 08502.*

*Satellite City, P.O. Box 836, Simi, CA 93065.*

*Top Flite Models, Inc., 2635 S. Wabash Ave., Chicago, IL 60616.* ■

# RPM Snark 5T

by MIKE LEE

***Type:*** *Sport Electric*
***Wingspan:*** *44 inches*
***Wing Area:*** *380 square inches*
***Weight:*** *38 to 44 ounces*


A NOVICE PILOT must have a good training ship to learn the ropes of flying. Whether it's gas, free flight, or electric, the basic training aircraft is a must. Without it, the learning curve is long and hard—plus expensive! The subject of this review is an ideal training ship for the electric aircraft enthusiast, the RPM Snark 5T.

THE KIT. The Snark 5T features a classic design high-wing trainer built with the famous E-Z ARF construction. This ship is really not a kit; it's an assembly of carefully built subassemblies which come together within hours to make a ready-to-fly aircraft. Total assembly time of the Snark was less than 4 full hours, which included the application of the decal trim. Assembly of an aircraft couldn't be faster or easier.

The Snark comes to you from Varicom Industries*. In the box, you'll find all the necessary subassemblies to make the Snark, from fully assembled wing halves already covered and decorated to the tiny screws and clevises. They even include epoxy. The airframe is a balsa and ply sub-structure covered with a vinyl and foam skin covering. All painting and decoration is already on the airframe, save for the application of a few trimming pieces. It's evident that great care has been taken to ensure that the airframe is as light as possible without sacrificing structural strength. Even the wheels are made of a light foam rubber to keep excess weight from building up.

ASSEMBLY. Assembly begins with the wing halves. Wing construction consists of merely fitting the halves together for the proper fit and then permanently joining the halves together with epoxy. Finishing touches mean placing the front and rear reinforcements and taping the center section joint. A whole 15 minutes and the wing is complete!

Fuselage and tail construction is almost as fast. Fit and glue the vertical stab to the horizontal stab and then place the assembly to the tail of the fuselage. At the front of the fuselage, fit the electric motor system. Any 05 size system will fit easily. Place the motor in the motor saddle and hold it in place with rubber bands.

Next fit the blow-molded ABS cowling. The great news is for once I've found an ARF cowling that was an exact fit the first time!

The last of the subassembly work is accomplished with the installation of the landing gear. This is the standard piano wire two wheel gear setup. Obviously, a tail-dragger setup saves weight. The remaining chores involve installing your favorite radio gear.

My Silver Seven radio has performed for some seven years now without a failure, and I've used it in no less than six of my favorite test aircraft. An outstanding radio system, the on-board components consist of two Bantam Midget servos and a 450-mAh battery pack. The Snark can easily accommodate a third servo for using a throttle to the motor. I opted to use a simple On/Off switch activated from outside the aircraft.

In the radio compartment the control surface pushrods are already installed. This saves a lot of hassle for the novice builder/pilot, as pushrod

*(Continued on page 104)*

# ELECTRIC MOTORS

(Continued from page 37)

Most motors come from their manufacturers timed to provide the most efficient power delivery for a given application, without exposing the motor to hazardous side-effects, such as heat or arcing. I'm not going into the timing of the motor, as this is best left to the experts or stout at heart. Suffice it to say that the motor you purchase will perform at its best 99.9% of the time without your having to retime it.

The example motor has the capability of being easily retimed through twisting of the endbell. Timing marks are provided on the can for reference, and there's also a reference arrow on the endbell. Timing advancement will provide higher rpm at the cost of less running time. Retarding the timing will slow the motor and lengthen the running time, but because this motor was designed to run 4 minutes, a couple of degrees of advance might put you in the lead of the race, but the motor might quit early when it drains all the battery power before the end of the race. By the same token, retarding the timing might make the motor last for you, but you defeat the design by doing so and you can get better performance by using a more appropriate motor.

Now we get to the very heart of the motor, the armature. This is what does all the electrical work by turning electrical energy into mechanical energy. The armature consists of two main elements: the poles and the commutator.

The poles are considered to be the portion of the armature that has copper wire wound around it. The armature of our motors features three separate poles, although motors for other uses can have dozens. The wire on the poles is of highly conductive copper. The poles themselves are ferrite-based, and when the wire is charged with electrical energy, the poles become electromagnetic. The electromagnetic field created by the poles interacts with the natural ferrite magnets in the motor can. The electromagnet tends to oppose or push away from the natural magnets in a set direction. You now have movement of the armature. Here is where the commutator comes into play.

The commutator is the element that provides the power to the individual poles. By charging only one pole at a time, the armature will make a movement to resist the natural magnets. But the pole will only move so far before the uncharged poles and the magnets hold the armature in magnetic balance. Just before this happens, the commutator provides energy to the next pole and cuts off the previous pole. The next pole makes its movement and the process continues. The faster the exchange of energy, the faster the armature moves.

A normal armature is moving anywhere from 10,000 rpm to a heart-stopping 30,000 rpm. Luckily, electricity travels at the speed of light, making even higher speeds possible. But funny things can happen even at the lower end of our speed spectrum.

At a mere 10,000 rpm, the kinetic force on the wire wrapped around the pole is incredible. The normal result is that the armature throws a wind and the motor is destroyed, something like throwing a rod in a hot street car. To prevent this, most armatures are glued after being wound. This can be a simple dip in a lacquer-based solution or the use of hot epoxy. At any rate, gluing is a must for

(Continued on page 80)

# ELECTRIC MOTORS

(Continued from page 76)

high-performance armatures.

To improve the performance of an armature you can also balance and true it. This is a process where the armature is first made perfectly straight and true while spinning, and is normally done on a lathe. The commutator can also receive this treatment. Competition motors are trued with diamond cutters. Truing the commutator prevents an out-of-round condition from robbing the armature of energy due to vibration.

Balancing the armature is a process which gives it a perfectly even weight distribution. This is performed by static means or dynamic means. A static balance means that the armature is balanced using its weight to determine the heavier areas, with no real spinning of the armature involved. Dynamic balancing determines heavy spots by spinning the armature and watching for the heavy spots to produce a wobble in the spin. This must be done using high-technology computers and it's expensive. Either method makes a marked improvement in the performance of the motor, sometimes doubling the performance, depending on the condition of the raw armature.

Now that you know of the motor components, how do you maintain the motor to keep it running in top form? Very easily, indeed.

We have found that foreign matter can foul the armature and slow it down. We also know that the brushes are in direct contact with the commutator and that means some type of wear. We have found that there can be electrical resistance from several sources, and that the magnetic forces at work have a great deal to do with the armature turning. Lastly, we know that timing can affect armature performance and balance. Let's now dwell on these facts to find out how to perform maintenance.

One of the most important things to do in maintenance is to keep the motor clean. Foreign debris, such as dirt, dust, lint, and anything else found on the ground, is going to get a shot at your motor. Make sure you clean it out. To remove dirt and dust, a motor cleaning spray such as Associated's Reedy-In-A-Can Motor Spray is very effective. Another more thorough cleaning method is to totally dip the motor in cleaner, such as Electro-Whirl from BoLink-Champion. This cleaner is totally non-flammable and non-conductive. Simply drop the motor into the cleaning solution and apply a little power to the motor while it's submerged.

If any part of the motor needs to be cleaned often, it's the commutator. Both types of cleaning are very effective. As I mentioned before, the brushes are in direct contact and they wear away quite fast. The residue from the brushes is hopefully expelled out of the can vents, but a good deal of it manages to get lodged in between the lands of the commutator. This residue will conduct electricity, causing the timing to go wrong, or in severe cases, causing shorting of the armature.

The bearings of the motor also require frequent service in order to keep them happy. While most Stock class motors are restricted to plain bronze bearings, upper-class motors, such as the LeMans 240, feature ball bearings. Both types require frequent and thorough lubrication in order to work well. A light machine oil, such as 3-In-1, works well.

Lack of lubrication will cause the bearings to run dry and fail. A failed bronze bearing could seize up and cause the motor to overheat. A dry ball bearing can also seize up; however, they usually self-destruct shortly afterward, making a real mess of the motor in the process.

When I mentioned that shunts prevented electrical resistance, I also mentioned that the brushes are held in place with springs to maintain contact with the commutator. You can ensure top performance here by checking the brushes and springs. Brushes should be free to move within the brush housing. Any dirt or grit will cause them to hang up and you'll lose contact with the commutator. The motor then stops.

To clean the brushes, carefully remove the brush springs and slide the brush out. It should come out easily. If not, spray the housing with motor spray to clean any debris. Now, inspect the brush for cracks or chips. A cracked brush will usually fail quickly and should be replaced immediately. A chipped brush will work, but it indicates that there may be other debris floating around that should be removed.

Now check the springs. They should have good tension and spring back to their exact position when compressed. If they don't, replace them because they will surely fail you later on. The spread of the spring ends should be at least 100° or more to be effective. Once checked and found to be satisfactory, replace the brushes and springs to their original positions.

Lastly, check the motor wiring for any worn or broken wires. Take a look at the main power wires in particular. These wires must maintain full contact with the power lugs, or you could find that you're not getting all the power possible. Use a multi-strand, high-voltage, and high-

temperature wire for motor power requirements. That will ensure that all the available power is getting to the motor.

The electric motor is quite a science. When running right, they are one of the cleanest and most efficient power sources around. And for those of us living in crowded areas where noise would otherwise prohibit R/C activity, they're the answer to our prayers. Treat your motors with respect and TLC, and they'll provide you with everything their little hearts can give you. They're easy to maintain when you know how, and now you do. Keep 'em running and keep 'em clean.

**The following is the address of the company mentioned in this article:*

*Great Planes Model Distributors, P.O. Box 4021, Champaign, IL 61820.* ■

## BASICS OF ELECTRICS

*(Continued from page 54)*

How much flight duration one can achieve with an electric is another frequently asked question. If you have a sailplane with an electric power system on board, you generally use the motor for climb only. When your model reaches the desired altitude, you cut the motor off and ride the thermals. For aerobatic models, the name of the game is power management, meaning that you cut the motor on and off during each maneuver. Electronic speed controls are available and work much the same as a throttle servo. The most common speed control is a simple On/Off toggle switch that is activated by the throw of a servo arm. The duration of your flight will range from 2 minutes to 10 minutes, depending on power management, the number of batteries on board, and the power system used.

Figure 1 shows a typical setup for an electric-powered airplane. Figure 2 shows the wiring schematic. You can add to the number of batteries, change the motor, add a speed control in place of the microswitch, or several other things, but you will still have the same basic setup. The wire gauge you use, if it is a custom or self-made system, should be large enough to allow maximum current flow with minimum resistance. Notice that everything is wired in series, like Christmas tree lighting used to be. If one thing fails, everything stops. A fuse in the system is highly recommended since it will save your motor, and possibly your whole airplane, should the prop or motor become stalled. The rating of the fuse can be anywhere from a 5-amp to a 100-amp, depending on the system.

The batteries you carry around in your airplane are the single most heavy aspect of electric flight. But this is your "fuel," and above that your "nitro." Batteries are generally Ni-Cd, rechargeable types of 1.2 volts DC. They are wired in series, meaning that they go from positive to negative to positive to negative, etc. This gives an accumulation of voltage from 1.2 volts up to as high as you want, but limited to the rating of your motor. The figures in Chart 2 will give you an idea of this. The nominal voltage for these cells is actually 1.25, so multiplying them by 10, for example, will give you 12.5 volts.

How do you charge the batteries? Nearly every maker of electric motors or systems has its own chargers. Some are custom-made for a particular system, others are adaptable or versatile enough to accommodate your needs. Some are quick charge, others are trickle charge. Some operate off of house current, others work off a car battery. In short, chargers are varied to the point of exasperation. Some batteries can be quick charged, while others cannot. Be sure that you don't quick charge a battery that's not made for it. The battery has a great warning sign—heat. If it gets hot while charging, chances are you're either charging it too fast, the polarity is reversed, or it is overcharged. Some chargers have protective circuits to prevent overcharging and these are a good investment. You should also know that as the batteries discharge in your airplane their temperature increases, so mount them accordingly. A warm battery while charging is normal. Charlie Kenney covers the subject of chargers on a more comprehensive basis elsewhere in this issue.

In summary the electric revolution is upon us. Your future in the hobby will depend on your acceptance and application of electric flight. If you doubt what I'm saying, watch this space 5 years from now.

**The following is the address of the company mentioned in this article:*

*Astro Flight, Inc., 13311 Beach Ave., Marina Del Rey, CA 90292.* ■

## ELECTRIC CHARGERS

*(Continued from page 42)*

charging, fast charging, overnight charging, or trickle charging. The auto charger has a built-in ammeter and voltmeter. The unit requires a 12V DC input source for proper operation. It's a very versatile unit.

**Leisure Electronics*.** Leisure has a

## ELECTRIC CHARGERS

very fine array of modern fast battery chargers. They are Models 104, 105, 106, and 107. Models 104 and 105 use an input voltage of 12V only. The 106 has an AC input voltage of 115V 60-cycle. The 107 can accommodate either a 12V or 115V 60-cycle input. The 104 is designed for a 6-cell pack, the 105, 106, and 107 can charge either 6- or 7-cell packs from 500 to 1,200 mA capacity. The Leisure chargers are well made and very attractive. All have charge and discharge features. They are fused, will trickle-charge, and have a charge-discharge meter.

**Pro-Tech*.** Three chargers are available from Pro-Tech; Models 701, 702, and 703. Models 701 and 702 have both AC and DC inputs (115V 60-cycle and 12V respectively). The 701 is capable of charging 4 to 8 cells, the 702 6 cells (7.2V) and 7 cells (8.4V). Two DC input cables are provided for all three chargers, one with alligator clips and the other a cigarette lighter adaptor. The AC input is provided by a conventional AC line plug. The 703 has a 12V input for 6-cell (7.2V) and 7-cell (8.4V) Ni-Cds. All three chargers have an automatic trickle-charge feature with indicator lamp, discharge circuit for equalizing Ni-Cd cells, and an ammeter to monitor charge and discharge. There is also a provision to use an external voltmeter. In addition, the charger is available with either an aluminum or black annodized front panel.

**Robbe*.** Robbe has the Automax 8 and the first thing that strikes you about it is its striking colors: a bright red plastic case, black front panel with white lettering, and a colorful black, red, and white meter. The Max 8 can charge battery packs from 4.8V to 9.6V DC with capacities from 100 mAh to 4,000 mAh. The Max 8 requires a 12V input and comes with an output cable utilizing a molex type connector which can be changed if you so require. To use the charger, connect the large alligator clips to a 12V battery, set the two slide switches to the correct range (i.e., a 1,200-mAh 7.2V pack would be set on the 1-1.6 Ah and 7.2V positions), press the start button, and your fast charge starts. The ammeter should read about 3.5 amps. When the charging current falls to 1.75 amps or roughly half of the initial charge current, the green LED (timer) will start to flash. The built-in 12-minute timer then goes into operation. When this period ends, the Max 8 goes

*(Continued on page 84)*

# ELECTRIC CHARGERS

*(Continued from page 82)*

into a trickle-charge mode and the green LED stays on. This process is stopped by pressing the stop button. The term "ACCU" on the front panel by the charging cable stands for "accummulator" which is the term Europeans use for batteries.

I had hands-on experience with Ace, Aristo-Craft, Astro Flight, Leisure, and Robbe chargers. Kyosho and Pro-Tech data was gathered from available published sources. Blank boxes in the charger summary reflect lack of data at the time this article was prepared.

**The following are the addresses of the companies mentioned in this article:*

*Ace R/C, Inc., 116 W. 19th St., Box 511C, Higginsville, MO 64037.*

*Aristo-Craft, Polk's Modelcraft Hobbies, 346 Bergen Ave., Jersey City, NJ 07304.*

*Astro Flight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292.*

*Kyosho, Great Planes Model Distributors Co., P.O. Box 4021, Champaign, IL 61820.*

*Leisure, 22971 "B" Triton Way, Laguna Hills, CA 92653.*

*Pro-Tech, Model Craft Mfg., 3455 W. 6th St., Los Angeles, CA 90020.*

*Robbe, 180 Township Line Rd., Belle Mead, NJ 08502.* ■

## BATTERIES

*(Continued from page 46)*

charge circuits and will safely perform discharging services. One complete discharge is all it takes, then allow the battery to sit overnight. Charge again in the morning and the battery will perform as expected.

Well, I've talked about the construction, performance, and characteristics of nickel-cadmium batteries. They are the best thing to happen since electric motors. Treated with respect and TLC, they'll provide the power to take to the morning air and stay there. Thank the boys behind modern technology for this one. ■

## O.S. FR5-300 SIRIUS

*(Continued from page 33)*

five-cylinder Technopower engine (see our test report in the December 1983 issue of *M.A.N.*) weighs little more than 25 ounces.

In contrast, the O.S. FR5-300 Sirius displaces nearly 50cc, or just over 3.0 cu in. and, in the interests of durability and performance, uses current model four-stroke technology so far as its individual cylinder assemblies are concerned. In other words, it has the (modified) top ends of five O.S. FS-61s, so, not surprisingly, when these are added to its very substantial crankcase, crankshaft, cam gear and induction assembly, plus its special radial firewall mount, the Sirius scales close to six pounds. Not that this is excessively heavy for a 50cc multi-cylinder four-stroke by present-day standards. It is on a par, relative to displacement, with the four-cylinder 40cc Pegasus (4.8 lb) and with the big four-cycle twins such as the 40cc Super-Gemini (4.4 lb), 45cc Saito FA-270T (4.8 lb) and 50cc Kavan Mk.II (approx. 6.4 lb with spark ignition equipment).

As the photos show, the Sirius is a most impressive piece of machinery. While the flat-four Pegasus would be the obvious choice for a realistic engine installation in a model of a typical modern light aircraft—most of which are powered by Lycoming or Continental flat-four or flat-six engines, the Sirius must surely win friends among those whose favorite aircraft belong to the twenties, thirties and forties era, when the radial was the most widely used type of engine in both military and civil aviation. There is a vast range of radial engined prototypes from which to choose and the fact that the radial engine, even when cowled, was such a visibly dominant feature of those aircraft, will undoubtedly tempt quite a few scale buffs, despite a price tag which must place this particular modeling item firmly in the luxury bracket.

Like most radial engines (the M-5, which was based on the 85 hp LeBlond engine, was an exception) the Sirius has its pushrods at the front (adding to its realism) and the cam gear is therefore contained in the crankcase nose. Understandably, with such a very different design, few parts of the Sirius have been inherited from other O.S. four-strokes. The exceptions are its pistons, valves, rocker assemblies and rocker covers, all of which are from the FS-61. The cylinder heads resemble those of the FS-61 but are slightly different.

Most of the engine is of machined bar stock construction, including the highly finished crankcase and the contrasting black anodized cylinder jackets. Unlike

## O.S. FR5-300 SIRIUS

other production model radial engines, in which the crankcase is used to distribute mixture from the carburetor to the cylinders, the Sirius follows full-size practice in having a separate inlet manifold. This is contained within the crankcase backplate and feeds mixture to the five inlet pipes from a centrally mounted automatic mixture control carburetor. Removal of the inlet manifold reveals an impressive all-machined master conrod and articulated rod assembly.

The engine comes equipped with a cast aluminum radial mount. This surrounds the carburetor and gives easy access to the needle-valve, choke control, etc., which are fitted with extensions for convenient and safe operation. The engine also comes with a full complement of tools and accessories, including a wiring harness with neat snap-on glowplug connectors enabling all wiring to be brought to a single point for connection to the glowplug battery.

All in all, the FR5-300 Sirius engine is a fitting achievement with which to mark the O.S. company's fiftieth anniversary as a model engine manufacturer.

Peter Chinn, c/o *Model Airplane News,* 632 Danbury Rd., Wilton, CT 06897. ■



## MRC CESSNA 172

*(Continued from page 63)*

spin but because I hadn't incorporated any motor control (an option is available for that), it had to be entered from a high-speed stall.

If you like to extract maximum performance from simple airplanes, Cessna 172 is just the right ticket. It can be flown inverted—very carefully—and, if you combine the roll and looping capability, you'll be surprised at the curlicues you can cut out in the sky.

Even so, given proper instruction, the airplane's response is soft enough (and strong enough—I couldn't damage it) to handle whatever a beginner can throw at it. The Skyhawk is not for the novice trying to fly by himself but, with an experienced flier, it can do the job.

When power runs out flights can be extended since this electric glides very well. While not a soaring aircraft it surely isn't a "lead sled"!

I found MRC's Cessna 172 Skyhawk to be a fine entry point into electric flying for the experienced R/Cer or relative beginner. It's a very fine sport flyer with surprising maneuverability. All in all, for time and money expended, this is a good buy in today's R/C market.

*The following is the address of the company mentioned in this article:*

*Model Rectifier Corporation, 2500 Woodbridge Ave., Edison, NJ 08817.* ■

## KYOSHO ZERO

*(Continued from page 59)*

had fun building, excuse me, assembling this one.

FLYING. For the most flying fun I recommend using a four-channel mini system for a full-house setup. I used a Futaba* Conquest 4NL with micro airborne and the amazing S33 micro servo. Don't get me wrong, the Zero will supply hours of dog-fighting fun with ailerons and elevator, but the addition of On/Off motor control and rudder really gives the most possibilities. For example, the Zero performs the most beautiful tail-high takeoffs from pavement one could ask for and rudder is needed for takeoff directional control. When I started flying the Zero at my local field one Sunday, all the guys left their scale and pattern birds to take their turn with my Zero. The reason? Simple. They saw how well it took off, flew, and landed. Their curiosity was so aroused by the little silent fighter that a few of them begged for a second and even a third try. Two of my flying pals now have their own Zeros.

The Zero really surprised me performance-wise, especially after the battery/motor combo really got broken in.

*(Continued on page 100)*

# Product News

## CIRCUS HOBBIES CYCLONE

The Cyclone is the newest helicopter in Circus Hobbies' line of Kalt helicopters and accessories. It's constructed of super-strength, fiber-reinforced, space-age materials and can be built in 4 to 6 hours without the use of special tools. Other features include Bell-Hiller mixing, a refined belt-drive tail rotor system, and unbelievable reliability and smooth performance for the novice or expert. For more info, write to Circus Hobbies (3132 S. Highland Dr., Las Vegas, NV 89109).


## CIRCUS GALAXY 8 RADIO

The Galaxy Computer 8 Multi-Function Micro Computer Radio Control System is the latest technology in remote control radios from Circus Hobbies (3132 S. Highland Dr., Las Vegas, NV 89109). The Galaxy 8 is the first transmitter that can handle seven completely different models. By entering the details about each model, including trim position, and entering one function code, you can fly any model that you have programmed. It's also the first to include a central processing unit (CPU) to provide all the special functions you expect from a first-class radio system.

## TRIM-A-PLANE TRIM KNIFE

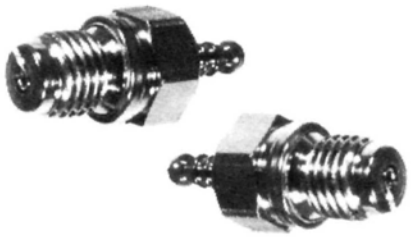
The Bradley Products (10120 Hammerly Blvd., Houston, TX 77080) Trim Knife is designed to precisely edge-trim excess covering material on your model. It can be used on all outside edges, straight or curved. The blade can easily be set from 1/16 inch to ¼ inch. The Trim Knife will make perfect overlap or butt seams easy. Knife set includes six blades.


## NEW FROM KOOKABURRA

Author Bernd Barbas brings you vast amounts of completely new information on scores of previously unknown Luftwaffe aircraft. He interviewed surviving ex-Luftwaffe pilots, ground crews, and families, building up a collection of several thousand priceless photographs, mostly from unpublished private albums. The results of this extensive research are two of the most exciting and revealing aviation publications in years—*Planes of the Luftwaffe Fighter Aces, Vols. 1 and 2.* A special offer is available to *Model Airplane News* readers only: both volumes are $60, postage paid (each volume is regularly $39.95 plus postage). Also included in the offer are four beautiful art prints of Aces' planes. For more info, write to Kookaburra Technical Publications (P.O. Box 648, Dandenong 3175, Victoria, Australia).

## TOP FLITE WRISTOCRAT

Top Flite Models (2635 S. Wabash Ave., Chicago, IL 60616) has just released its latest radio-controlled sailplane kit, the Wristocrat. Designed by Scott Christensen, the Wristocrat is easy to build, easy to launch, and fun to fly. The airfoil is a modified Eppler 205, providing excellent lift and penetration characteristics. With a 56¼-inch wingspan and 10½ to 13 ounces of flight weight, it's a thermal rider *par excellence.* The wing area is 335 square inches with an aspect ratio of 9.9:1 and a loading of 4 to 6 ounces per square inch. The Wristocrat will accommodate your favorite small servo, two-channel radio gear, and comes complete with a full hardware package.



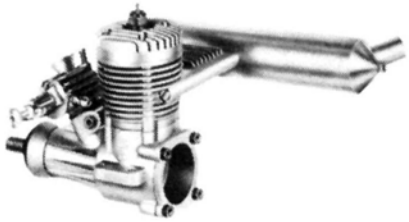
## FOX 4-CYCLE GLOWPLUG

Fox Manufacturing (5305 Towson Ave., Fort Smith, AR 72901) introduces the new four-cycle special glowplug as an addition to its fine line of motors, glowplugs, and accessories. The Miracle Plug is a new concept in design, with several new features that enhance its ability to retain heat and boost performance. There's no need for an idle bar and this plug provides maximum power and reliability. For more info, contact Fox.

Descriptions of new products appearing in these pages were derived from press releases supplied by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, or guarantee of performance or safety by **M.A.N.** When writing to the manufacturer about any product described here, be sure to mention you read about it in **Model Airplane News**.

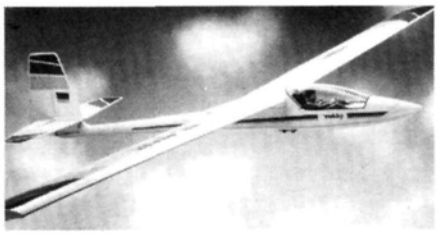
## THE "RIGHT STUFF"

The Right Stuff is a new hand cleaner from Great Planes Model Manufacturing (P.O. Box 721, Urbana, IL 61801). It has been formulated especially for modelers to remove the oils and grime commonly found in the workshop and at the field. Best of all, it works! Fuel residue, adhesives, paint, grease, ink, and graphite are only a few of the things easily removed by this amazing fresh-smelling lotion. It can also be used without water! No field box should be without Right Stuff, so pick up a bottle at your hobby dealer today.



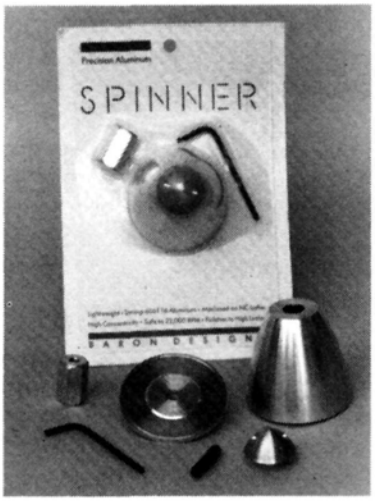
## K&B .20 R/C SPORTSTER

The .20 R/C Sportster is a new plain bearing engine designed and engineered for the sports modeler. It's made of a new high-tech material that's tough and long-wearing. It features an A.A.C. cylinder and piston, Schneurle-scavenging, a new carburetor with easy idle adjustment, and a secured double-lock draw bar that ensures a permanent hold. The .20 Sportster is a durable, excellent-performing engine. For more info, write to K&B Manufacturing (12152 Woodruff Ave., Downey, CA 90241).



## ROBBY R/C START

The R/C Start from Robbe (180 Township Line Rd., Belle Mead, NJ 08502) has a straightforward design and a high degree of pre-fabrication, making it perfect for the beginning sailplane enthusiast. The high-lift airfoil and generous dihedral of the Siroskompakt wings are combined with a long tail moment to give the R/C Start the natural stability necessary for learning how to fly. The specifications are: wingspan, 94½ inches; fuselage, 49¼ inches; wing area, 635½ square inches; tailplane area, 108 square inches; weight, 47½ ounces; and wing loading, 10.7 ounces per square inch.




## BARON DESIGNS SPINNER

A precision, lightweight, aluminum 2-inch diameter spinner is available from Baron Designs (5711 Betty Place, Los Angeles, CA 90042). The spinner components are NC machined for high precision. T-6 aluminum is used for the body, backplate, nosecone, and prop nut. The steel 10-32 attachment stud is removable from the nosecone with the enclosed Allen wrench if a different length is required.


## HOBBY LOBBY MINI DRILL

This tiny high-speed drill from Hobby Lobby International (5614 Franklin Pike Circle, Brentwood, TN 37027) is less than 5 inches long and fits into confined spaces. The Como Precision Drill runs so smoothly that it's one of the few small drills that can use the Dremel cut-off discs without shattering them. The drill can be operated from any 6V to 18V DC source, but its most unusual feature is that it can also be operated from a small, low amperage battery charger. The Como Drill comes with four collets ranging from 0 diameter up to ⅛ inch diameter, two chuck spanner wrenches, and two alligator clips so you can connect the drill to any type of power source.

## ¼-SCALE CAP'N EDDY

Ace R/C (116 W. 19th St., P.O. Box 511PR, Higginsville, MO 64037) announces the ¼-scale Cap'n Eddy pilot figure. Ever since they came out with the 1/6-scale version of this highly detailed figure, modelers have been asking for a ¼-scale version. Well, you asked for it—you got it! Both versions are available painted or unpainted.

# KYOSHO ZERO

*(Continued from page 92)*

I'm not saying it has pattern ship vertical performance, it doesn't. It simply supplies you with a lot of refreshingly clean, quiet, fun drawing curlicues in the sky.

Just for the record, the spinner that comes with the Zero is better left off. Mine was quite out of round. Just as with any spinner and prop, the spinner and prop on an electric should be balanced and true.

I must admit I was a bit skeptical when I first saw the Zero, but after many flights, tall loops, and left and right snap rolls with immediate recovery, I was not only convinced, I was on the phone with Bob Repta at Great Planes begging for a Corsair. I only hope Kyosho continues to bring us sport flying fun lovers more products we can relate to like the Zero.

**The following are the addresses of the companies mentioned in this article:*

*Great Planes Model Distributors, P.O. Box 4021, Champaign, IL 61820.*

*Futaba Corporation of America, 555 West Victoria, Compton, CA 90220.* ■

# ASTRO CHALLENGER

*(Continued from page 55)*

geared motor and seven Sanyo 800-mAh fast charge nicad cells. I chose the small Geist prop (13x7) and the Astro electronic switch. The total power system weighs 19.6 ounces. My model with radio weighed 19.9 ounces.

CONSTRUCTION. The construction of the Challenger is straightforward. The wing and tail use conventional open frame construction. The wing has spar webs extending all the way to the wing tips for maximum strength. Both spars and the leading edge are bent backward to achieve the elliptical planform. I built the original wing dry, but if the bending of the spars and leading edge seems difficult, then wet the spars and leading edge, towel dry, and you should have no trouble bending them. The wood should be left to dry a couple hours before gluing to the ribs.

The stab uses two pieces of balsa for the leading edge. Pin these to the plan, then Hot-Stuff them together. The photos should answer most of your questions.

FLYING. On its first flight the Challenger climbed to about 500 feet in 15 seconds in light lift. The glide was very flat, this model will float with the best of them. Its stall was gentle and the model

*(Continued on page 104)*

# ASTRO CHALLENGER

*(Continued from page 100)*

would bobble up and down without dropping a wing. The elliptical tips were working perfectly. In the glide the turns were slow and majestic. Power on the rudder was much more effective, the Challenger would do nice rudder rolls and would fly inverted with just a bit of forward trim. With the 6° of down thrust, you will need only a click or two of down trim to keep the nose down in the climb. On the first flight I got seven climbs on a battery charge, but there was light lift at all times. I landed after 45 minutes because I was carrying a 250-mAh receiver battery.

The next morning I went out early before any lift had developed and took three battery packs. To get some sort of calibration I climbed for 30 seconds, then glided until about 10 feet off the ground, then repeated the climb. I could get three solid climbs from a charged pack and averaged 24 minutes per flight. I knew I had a winner!

If you're like me and need all the help you can get to challenge the experts, then maybe the Challenger is for you!

**The following is the address of the company mentioned in this article:*

*Astro Flight, Inc., 13311 Beach Ave., Venice, CA 90291.* ■

# RPM SNARK

*(Continued from page 65)*

installation can be a big headache. Once the inner plastic pushrod is fitted, simply apply double-sided sticky tape to the servos and stick them to the side of the fuselage interior. Instant flight surface trim!

My particular Snark was fitted with the Leisure* 05 flight system. No problem here, as the Leisure 05 strapped right in place. Power for the system is supplied by a 1,200-mAh, 6-cell battery, which slides into the underside of the Snark and is held in place with a simple but effective plywood latch. Further security is provided with strips of foam tape which make the builder wedge the battery in place. I tried my best to make the battery fall out but it stayed in place. A 7-cell battery can also be used if the need for more power arises.

From here, you can now head to the flying field and quietly test out your new Snark.

FLYING. Not having flown anything

*(Continued on page 107)*

## RPM SNARK

*(Continued from page 104)*

but electric-powered sailplanes, the opportunity to fly a trainer/sport ship on electric was truly something to look forward to. The test day was sunny and hot with no wind. This is really not the best situation for electric planes, as hot air provides less lift to an aircraft's wing and that means less thrust from the prop. Nonetheless, I pressed forward and was ready in short order.

Flying the Snark is a pleasure indeed. She took off nicely from a leisurely hand launch and proceeded to sail off as pretty as you please. She flies easily, displaying excellent stability and good climb. The prop size was a measly 7x3.5 Cox grey prop. I could have gotten more power from a different prop, but there was no need to—I was having fun. Hands-off flying was almost like a free-flight model. The Snark probably would have headed off into the wild blue yonder all by itself.

After a couple of pictures, I handed the Snark over to a neighborhood kid who I had put on the transmitter sticks only twice before. For him, the Snark was "easy" to fly; this from a kid with maybe 15 minutes to his flying credit. After about 8 minutes of kicked-back flying, we brought the Snark around for a nice two-point landing within just a couple of feet of where we stood. That Snark is a well-trained bird.

Overall, the Snark 5T is an excellent candidate for the newcomer to electric-powered flight, or to the sport of model aviation for that matter. It has great flying characteristics, goes together rather quickly and easily, and, best of all, leaves no mess to clean up after a good day of flying. What more could you want from any bird? The RPM Snark 5T could be the ticket to your next flying adventure. All aboard, please.

**The following is the address of the company mentioned in this article:*

*Varicom Industries, 18480 Bandilier Circle, Fountain Valley, CA 92728.* ■

## KYOSHO VALENCIA

*(Continued from page 58)*

seconds into the flight, the spinner cap flew off and about a minute later, when Nick shut the motor down to glide a bit, the prop, screw, washer, and spinner backplate departed. Now we really had a glider! It's a heck of a way to demonstrate a system, but the Valencia took it in stride! This points up an absolutely essential requirement: before installing the motor/gearbox and prop assembly, make sure all the gears are properly aligned and then Loctite each screw, including setscrews. I also lubricated all the gear mechanisms with Lubriplate; it helps quiet gear noise.

On the positive side of the first flight teething problems was the ability to test the spare parts availability system, a call to Great Planes had my new prop, spinner, and hold-down screw in hand within three days. Great support! After doing everything which I probably should have been smart enough to do originally, subsequent flights went extremely well, even in moderate wind. The in-flight shutdown/restart capability really is a lot of fun. I haven't yet caught any thermals, but I suspect they'll be easier to "chase" since power is available. The use of a prepared surface like a runway is probably going to be essential because of the tiny wheels and especially the wheelpants. You might try leaving the pants off for grass ROGs. I haven't yet, but I have hand-launched with no problem.

One thing I have noticed is with regard to the 7.2V Ni-Cd pack which supplies juice to the motor. Neither of the two packs I used have performed as well as they did the very first time I used them. The only difference I'm aware of is that the second and subsequent charges were quick charges using a field charger operated from my car's cigarette lighter. Even though they were short duration charges (less than 20 minutes), I noticed that the packs were extremely hot to the touch. This is a no-no and will probably mean the demise of your packs in short order. The thing to do is to fly the pack until it's nearly depleted, then recharge it, being careful not to allow the heat to build up. It's kind of like the cycling procedure we perform on our radio batteries to break memory.

If you haven't yet tried electrics, give it a shot. It's different and enjoyable and also demonstrates that airplanes really can fly on wings rather than raw power. I'd recommend the Valencia to nearly everyone as a trainer because it gives

## KYOSHO VALENCIA

time to think, most important to the first timer. Chris Chianelli was so enthusiastic after I told him about it that *he's* even ordered one, which is great because there's nothing to build, cover, or finish, eliminating most of his problem areas. I think he ordered an extra one for Frankie T., mentioning that since it was electric and didn't have a needle-valve, the engine would probably last one more flight.

Beginners and experts can each find lots of value in the Valencia. I have. Now if I can only get the motor to turn a rotor to 23k, my ducted-fan F-4 should do what it does best—quietly!

**The following is the address of the company mentioned in this article:*

*Great Planes Model Distributors, P.O. Box 4021, Champaign, IL 61820.* ■

## SOARING NEWS

*(Continued from page 48)*

me hanging on behind. Bert did the right thing and mushed us straight ahead into the grass. The glider suffered some damage to the tail and the Eaglet broke its prop.

"What did we learn? An Eaglet with some aerodynamic modifications and a .25 to .30 in the nose will tow gliders up to 80-inches span. Perhaps a better ship would be a modified Eagle 63 with an O.S. .28 in the nose. That ship, with barn-door flaps, would fly like a kite. Install a glider-style quick release in the tail of the tow ship and use the hook in the nose of the glider, and you'd be in business. Also, the longer the towline, the easier it is. Initially we started with about 25 feet, but soon went to 35 (all I had) and things went better. Some 35 to 40 feet of the bright orange nylon with a painted ping-pong ball at either end for visibility would be fine. Rubber bands worked well because their gentle flexing kept good tension on the towline. (Using one as a weak link with several multiples might offer the safety of breaking the line if things got too crazy on tow.)

"Whatever the ship, a slow steep climb with a minimum of turns would yield good launches and quick tow ship turn-arounds. The ability to spin your tow ship really helps in getting down safely and with little aerodynamic loading due to high airspeeds in a dive.

"All in all it was fun taking ordinary equipment and supplies and doing something radical with them."

This is the first of two letters from Ray. I'll print the follow-up letter next month.

A correspondent from the Snake River Soaring Club* sent in a magnificent color photo of Tom Gridley launching Mark Altman's Two Tee sailplane from the top of Gros Ventre Butte in Jackson Hole. The view of the Grand Tetons in the background is overwhelming. The sailplane is bright yellow with a black leading edge and a black elevator. The two wing-joiner stripes are bright red, matching Tom's hat. The mountains are snow capped against the clear azure sky. I think the whole point of sending us this totally demoralizing scene is to encourage us to attend the meet that is planned for September 13 and 14 at the Spring Creek ranch. Write to the club if you're thinking of going.

Jim Gray, c/o *Model Airplane News*, 632 Danbury Rd., Wilton, CT 06897.

**The following are the addresses of the person and organization mentioned in this article:*

*Ray Stark, 2501 Buttonwillow Parkway, Abilene, TX 79606.*

*Snake River Soaring Club, P.O. Box 7467, Jackson Hole, WY 83001.* ■

# MRC ROSSI R40-FI

*(Continued from page 35)*

that means, first and foremost, generous porting to provide good breathing which, in a shaft rotary-valve design means, in turn, a large diameter crankshaft. Over the years, the shaft diameters of front intake .40s have steadily increased as designers have sought more power through larger shaft passages and rotary-valve areas. At one time, 12 mm or ½-inch (12.7 mm) was considered adequate, then 13 mm and 9/16 inch (14.3 mm) sizes were used, before the 15 mm size, already widely used for .60 size engines, was adopted for most of the top front-intake .40 and .45 size motors during the 1970s. In 1980, O.S. went one better with a 16 mm shaft for their high-performance Max-40VF and 46VF models, but the Rossi R40-FI uses a massive 17 mm shaft. This is mainly for the purpose of increasing valve port area. The gas passage through the shaft remains at a "normal" 10.8 mm diameter, but the valve port is 18 mm long and around 300 sq mm in area. This makes it wider than the inlet port through the casting, as a result of which the latter is fully uncovered for approximately 50 degrees during the engine's induction period which, according to our measurements, begins at 42 degrees ABDC and closes at 60 degrees ATDC.

Like all current Rossi engines, the R40-FI has a development of the basic Schnuerle scavenging system, in this case a conventional arrangement of two angled ports flanking the exhaust port, plus an upwardly inclined third port diametrically opposite the exhaust. Cylinder port timing is in line with what one would expect of an engine designed for high performance but not specifically for racing use with a full tuned-pipe exhaust system. The exhaust port is open for 146 degrees of crank angle while the three transfer ports are open for 130 degrees.

The engine is of the ABC type and the chromed brass liner is accurately located in the casting to align the ports with the three well-shaped bypass passages. The cylinder head assembly is machined in two parts: a combustion chamber insert and a finned outer component. The former has a deep, almost hemispherical, 13 mm diameter bowl, surrounded by a flat 4 mm wide squishband, and the latter is anodized black and tied to the main casting with six 3.5 mm slot-head screws.

The crankshaft is ground all over, has an 8 mm diameter front journal and a 6

*(Continued on page 112)*

## MRC ROSSI R40-FI

*(Continued from page 110)*

mm crankpin on an 8.2 mm thick crankweb that is partially milled each side of the pin for counterbalancing. It is coupled to the gravity cast ringless aluminum piston by a machined conrod, bronze bushed at the lower end only, and a 5 mm o.d. hollow wristpin retained by wire snap rings. The piston is light at only 6.8 grams, increasing to 8.8 grams with the addition of the wristpin. The conrod is 37.5 mm between centers—unusually long at 1.974 x stroke, which has the merit of reducing piston side thrust at the expense of a slight increase in cylinder height and engine weight.

Mention of weight reminds us that this is a very solidly built engine, with a very robust but beautifully cast and machine-finished main casting embracing the crankcase, front housing and full-length finned cylinder casing. It is no lightweight, among .40 size engines, at over 15 oz bare or 17.5 oz with the special short tuned muffler supplied with it. It comes with a Rossi automatic mixture control carburetor. This is of an orthodox barrel throttle, two-needle pattern and is available with a choice of two choke sizes: 8.5 mm bore for use with a muffler pressurized fuel system, or 7.7 mm for use with pressure or unassisted suction feed.

The manufacturer specifies a fuel mixture of 4 parts methanol to 1 part castor-oil with the addition of 3-5 percent nitromethane, while the recommended prop size is 10½x5 or 10x6. Incidentally, if production samples of the R40-FI are capable of reaching the manufacturer's rated output of 1.95 bhp at 17,000 rpm, this would, in fact, call for props of at least this size, to prevent the engine from going beyond the 17,000 rpm power curve peak (and thereby losing power) in the air.

Peter Chinn, c/o *Model Airplane News,* 632 Danbury Rd., Wilton, CT 06897. ■

## MISS L.A.

*(Continued from page 56)*

I was really appreciative of the fabulous adhesives and covering material I used for Miss L.A. If only I had this stuff when I was growing up! Pacer's* Zap CA+ provided plenty of strength with little weight. Coverite's* new Black Baron film went on beautifully, with a lot less heat than I'm used to using.

CONSTRUCTION. Building Miss L.A. went remarkably quickly, mostly because there's very little to build. Electrics are forced to carry a heavy load of Ni-Cd batteries and are incredibly allergic to overweight airframes. Fortunately, the pounding delivered by single-cylinder engines is totally absent. This allows an electric plane, especially the fuselage, to be built very lightly. Plywood, extensive doublers, and massive firewalls just aren't necessary.

Study the motor mount system shown on the plans. It's very simple and can be made to accommodate practically any electric motor. Check the dimensions of the motor you intend to use before you start gluing. Davey recommends either cobalt or standard 05 motors, preferably with a gear reduction unit. The cobalts deliver maximum power, the standard motor will do a good job at considerably less cost.

The fuselage has plenty of room for batteries and I recommend either six or seven of the 1,200-mAh cells. These will give more power and a longer flight than the smaller but lighter 800-mAh cells.

There isn't much to say about the construction of the wing, just make sure to keep it straight. The only place I took the liberty of adding structure to the plane was in the wing, where I installed an extra set of webbing to the back of the spars to add a little stiffness. Now I'm not sure it was needed. Use a light touch on the sanding block, it would be easy to sand right through a spar.

As I mentioned I covered the model with Coverite's Black Baron film, which really did a great job. Heating really shrinks out wrinkles, and somehow did not warp the very light frame. In fact, it seemed to add a great deal of stiffness to this bird. Use a cool iron for Black Baron (around 1.5 on my thermostat). Hinging was done with the very light, very thin Pro Hinges put out by Radio South. They are almost paper thin and work well in the very thin tail surfaces of Miss L.A.

My model had a total weight of 45 ounces, which put the loading at around 18.5 ounces per square foot. This is a terrific loading, especially when you con-

*(Continued on page 116)*

## MISS L.A.

*(Continued from page 112)*

sider that the motor and battery were more than half that weight. This plane needs a compact radio system so I used a standard receiver with bantam servos and a 250-mA battery pack. Throttle control was a simple On/Off switch.

FLYING. While I was readying the B-2 for flight, there was a pessimistic non-believing onlooker espousing adjectives of impending doom while chain-smoking in my face. Needless to say, when he discovered I intended to ROG from grass he laughed and said, "That thing will barely get off smooth pavement." I must admit I did have some doubts about taking off from grass, but you never know unless you try.

And try I did! Holding lots of up-elevator to prevent a nose-over on initial roll out, and releasing it as the B-2 gained speed, to my amazement—and to my pessimistic friend's chagrin—little Miss L.A. got light on her wheels and rose into the air.

The B-2 is very smooth and predictable. It tracked very nicely through loops and moved along at a very good clip. Initially the ailerons were too slow, but after giving them more throw, the rolls were quite acceptable. Much of the B-2's success is due to the turbulated airfoil. The extremely well-designed wing really lets you slow up for landing.

In my opinion, we need many more scale-looking electric kits that incorporate the design concepts of the B-2 by Davey Systems. This electric truly works. It does what an airplane should—fly!

Oh, by the way, my loud-mouthed friend was sheepishly quiet after he witnessed little Miss L.A. fly.

**The following are the addresses of the companies mentioned in this article:*

*Davey Systems Corp., 1 Wood La., Malvern, PA 19355.*

*Pacer Tech, 1600 Dell Ave., Campbell, CA 95008.*

*Coverite, 420 Babylon Rd., Horsham, PA 19044.* ■

## PATTERN MATTERS

*(Continued from page 30)*

by the flight line official immediately following the flight. No modification or adjustment to the model shall be permitted (other than refueling). The model shall be retested by a second noise steward using a second noise meter and in the event that the model fails the retest, the score for the preceding flight shall be zero." *(OUCH!—MSL)*

Another "wow" for this rule, but it's not as bad as it looks in print. As a matter of fact, at a recent meet in Southern California, eight pilots entered in the FAI event used this standard to see what the result would be. Just to set you straight, four ships were two-stroke-powered with pipes, and the other four had .90 to 1.20 four-strokes. (Three were 1.20s.)

Using the above criteria, we used two meters and found that only one piped two-stroker (mine) failed the noise test, while only one four-banger made the test! Of the bunch, the ships of Chip Hyde and Steve Helms were by and far the quietest not only on the ground, but in the air as well.

It's a bit of a surprise for those who get to the line and find out on the second flight that the ship failed. In effect, by the time you find out that the ship was too loud, you have just been completely eliminated from the competition! But this is the only way to ensure that the ships are totally ready and conform to the rules. It also effectively closes the door on anyone playing with an in-flight mixture control to fool the judge and then opening up in the air. Speaking of the air, the next part of the noise rule also enforces total preparation of the model:

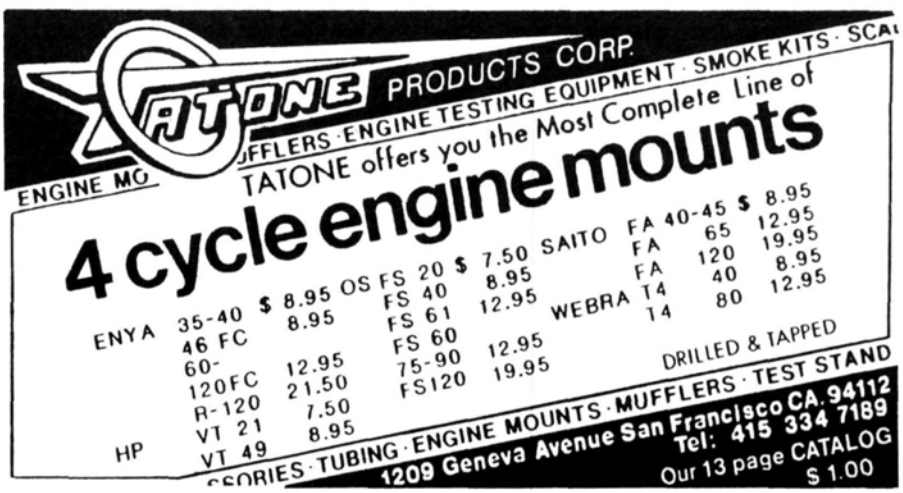
"At the conclusion of each flight, each judge will independently score the model for in-flight noise level, indicating if the model is too noisy, average, or very quiet. If a majority of the judges score the model too noisy, the modeler's flight score will be penalized 5 points for each counted judge. If a majority of the judges score the model very quiet, a 5-point bonus for each counting judge will be added to the flight score."

Now, I see this one as good and bad. The good is that modelers will try to make their models as quiet as possible for the contest. The bad is the amount of points that can be awarded. With a bonus or penalty of 5 points per counted judge, and that can be all of the judges, you could end up with an unjust bonus or penalty.

Take, for instance, a fairly local contest where three judges will score the flight. A contestant could gain or lose 15 points. Add that up for a three-out-of-four flight score and you have a 45-point shot in the pants or birthday present. This difference could actually allow a pilot with inferior flights to be in contention with a pilot whose flights are superior. Yet, the idea was to be judged by the technical quality of the maneuvers. I think that maybe this one went too far, but that's only my opinion. How about you? Write me and let me know how you feel about it.

By the way, there was also the notion of changing the FAI sequence itself every once in a while—not a bad idea and one





that I would back wholeheartedly. After all, if it stays the same forever, things will get pretty dull and there will be an awful lot of pilots who can fly the present sequence well, but not much of anything else. Drop me a line on this one as well. Let's see what the pilots who really care think.

### New Things

I found a new little item on the market the other day that answers my problems on the flight line. Seems like when you travel to the line light, you bring only the electric starter, a glowplug igniter, and the bird with radio. Of course, the most common thing to follow is an engine that won't start. Flip and prod as you may, the engine refuses to bark and you find out later that the plug was shot. Well, I do that a lot and the plug doesn't fool me anymore.

McDaniel R/C*, makers of the world-famous Ni-Starter, has a new Metered Ni-Starter. This little jewel has a meter mounted at the end of the unit, allowing easy reading of the plug condition. Simple to use, it features the same great Head-Lok adapter and comes with its own wall charger for overnight refueling. It's a worthwhile investment for sport and competition pilots who travel to the line light. See your dealer.

I also managed to get a handle on the landing "bounce" problem the other day. You know, you bring the ship in a little hot and it bounces all the way down the strip. Of course, the same ship probably bounces on anything but the nicest landing. Try this for a change.

Mount some foam tires on the bird. Yup, foam tires. They're available from MK Models, IM Models, Tetra, and a few others. These wheels are either plastic or aluminum rims with sponge rubber foam for the tires. The tires absorb enormous amounts of shock on landings and don't rebound the ship. You'll be amazed at how much less your ship will bounce. Another nice thing is that they're lightweight. Try them.

'Til next month, we're on the pipe and airborne (with less bounce).

Mike Lee, c/o *Model Airplane News,* 632 Danbury Rd., Wilton, CT 06897.

**The following is the address of the company mentioned in this article:*

*McDaniel R/C, Inc., 12206 Guinevere Rd., Glenn Dale, MD 20769.* ■

## SKEETER

*(Continued from page 24)*

With my single-motor Electra Sportster (see May '85 *M.A.N.*) I had satisfying sport aerobatic flight with electric power. With the Skeeter's dual-motor improvements, performance is carried a couple of steps further; in fact, considerably more than I'd hoped for. The Skeeter easily jumps off pavement in about 20 feet, then climbs out at a respectable angle and speed. The first turn back comes with authority and the following flyby shows impressive speed and agility. With the ample thrust, maneuvers are easily and consecutively accomplished. Simply fly the aerobatics you want.

I did note one difference with twin motors. With the points of thrust being away from the aircraft centerline and line of flight, twins tend to be sluggish in axial rolls. Increasing the aileron throw tightened them up nicely. One flight characteristic separates a twin from all others—there is no sound as scintillating as two props in perfect synch at full bore!

For an energy source I used fourteen SR* 1.2-amp cells at a nominal 17.5 volts. This powers two Astro Flight* Cobalt 05 motors, which are equipped with 2.2:1 Astro gearboxes and turn 11x7 props at 5,800 rpm. However, best maneuvering has come with 11x9 and 12x9 reworked props. The motors are controlled by an Astro electronic relay switch. The R/C equipment is a standard size 4-channel, although the available lighter servos and battery would be sufficient and would help with the weight.

With multi-motors there are two possible hookups for the motors and battery: parallel or in series. I did some bench testing of both and discovered that with the parallel configuration the battery voltage is the norm for *each* motor and *both* motors are wired directly to the battery. With the series configuration, the battery voltage is doubled, as all the cells, switches, and motors are like links in a chain. The motors divide the voltage between them so that they actually run at normal voltage. The only appreciable difference was about a 500 rpm increase with the series circuit. I believe this is because there is considerable wiring when motors are located in nacelles. With the higher series voltage, the motors see less of a voltage drop due to wiring resistance. I opted for the greater series thrust and it has worked fine.

My standard Astro Flight* charger has a 7- to 8-cell limit, so I needed something for fast field charging. My solution was to add an Astro Voltage Booster to my standard charger and performance has been excellent.

CONSTRUCTION. The structure of the Mosquito is designed to provide the necessary size and strength with as little weight as possible. While not expected to

be crash-proof, it has proven adequate for flight loads and the occasional hard landing. You'll find some unique methods used in the construction and I suggest that you do not deviate from them. Beefing-up electrics is a no-no and will only detract from performance. The use of cyanoacrylate adhesives helps control weight and none of the balsa should be over medium weight, with an even lighter weight preferred where practical.

The tail structure is built-up for both aerodynamic and weight purposes. It's possible to have thicker, more efficient airfoils without the weight of solid wood. For alignment assurance and assembly simplicity, I assembled both the tail and the wing in saddle jigs.

A twin's wing has additional loads and needs. There is about ¾ pound of nacelle slung out on each panel. Also, with nacelle-mounted landing gear there is about a 3-pound load at the center, which is amplified during hard landings and in maneuvers, so abnormal strength is needed in the center section between the nacelles. This is provided by a more complex box spar, which furnishes the needed strength with the desired lightness. Note that no spars are required outside of the nacelles. With this stressed-skin structure, assemble the wing inverted on a dihedral board using saddle jigs. In this manner locate the top sheeting in the jigs, then simply install all the internal structure on the top sheeting. After this you can easily apply the bottom sheeting to complete the assembly. You won't strain your back lifting it out of the jigs either, it'll be light!

Add the tips, leading and trailing edges, and ailerons after removing the wing from the jig. To construct the ultra simple and light tips, first cut the top sheeting to exact shape, then add the 1/16-inch triangular bulkheads a bit oversize. Fair the bulkheads in from the tip rib to the sheeting outline with a long sanding block. Apply the bottom sheeting at this time.

Glue on the oversize leading and trailing edges and hold with masking tape. Carve and blend to shape with a sanding block.

With the elimination of torsion rods, the ailerons require extra attention. Use *stiff* balsa to prevent flexing. I soaked the inboard portion with cyanoacrylate to increase stiffness. Midwest Products* polypropylene strip hinges are well proven, weigh almost nothing, and are simple to install. Fasten them with a drop of cyanoacrylate.

The nacelles are simple box structures with styrofoam added to create the desired contours. Note that the motor mount bulkhead is heavier birch plywood so that it can be tapped for mounting screws. Attach the coil spring landing gear struts to the bulkhead with soft wire and ample epoxy. Carl Goldberg Models* nose gear struts proved to be the needed size. When the box is completed, rough the 1-inch sheet styrofoam fairing to outline shape and attach it to the box with Titebond water-based cement. Use this for all foam joints. Then carve and sand the foam to contour.

Cover both the nacelles and fuselage with 1½-ounce glass cloth and epoxy resin; thinned Hobbypoxy II* will do. For simplicity, cover the nacelles and ready them for paint *before* attaching them to the wing.

There is some wiring to be done before installing the nacelles on the wing, and just aft of the wing spar I left off a 1½-inch wide strip of sheeting to facilitate

the wiring. I used SR brand motor wire for its high efficiency and flexibility, although any good quality 16-gauge multi-strand copper wire will do. Three suitable connectors are required, one for each motor and another for a disconnect at the fuselage. In the wiring diagram, note the common wire running from the plus terminal on one motor connector to the minus on the other. The remaining two terminals are wired to the fuselage disconnect. Observe proper polarity and allow enough slack for connections.

Sand the wing sheeting and ready it for covering, then install the nacelles. Align the nacelles to the wing/fuselage centerline at 1° positive incidence. Check the incidence to the motor centerline (shaft). You can assure the alignment by first scribing an accurate wing centerline on the bottom sheeting; then scribing nacelle centerlines parallel to this, 7½ inches out on each panel. When the nacelles have been aligned to these, glue them to the bottom sheeting.

Fabricate the fiberglass cowls by first fitting an oversize ⅛-inch sheet balsa former to the base of the gearbox, then match the outside to the nacelle shape. The 1/16-inch plywood spinner ring has an initial hole, which is a tight fit on the motor drive washer. Use pieces of foam to fill in between the spinner ring and former, around the gearbox. Tack-glue in place. Carve and sand the foam to shape, then cover with three layers of 1½-ounce glass cloth and resin. Fasten the cowls to the motor bulkhead with two 2x⅜ wood screws.

Make the motor cooling air intakes (scoops) of 1/32-inch plywood. To form them, saturate them with Windex glass cleaner and wrap them onto a 1-inch diameter broom handle. Hold with masking tape until dry. Note that the air exit is where the landing gear "well" would be.

One nice thing about a twin is that the fuselage can be as simple as possible. In this case it is a box with foam added for fairing to contour. Scribe a centerline on your building board and locate the bulkheads on it. Attach the sides upside down so the bulkheads are at an angle to the assembly board. Make a simple angle jig and use it while spot-gluing the bulkheads to the assembly board. Install the sides around the bulkheads. While the assembly is on the board, install all the internal structure possible from the bottom side. When it's dry, remove from the board and add the remaining internal structure.

Even though you're now in the middle of construction, this is a good time to install the radio gear. Temporarily fit the tail assembly in place and tack-glue it. Install the servos in their rails. Route the rudder and elevator pushrods to their horns, and use plastic tube fairleads where the rods exit the fuselage sides. About halfway between bulkheads C and D install a 1/16x1-inch plywood fairlead guide between the fuselage sides for the pushrods. Remove the servos and tail to proceed.

Shape 1-inch styrofoam to oversize outline and glue to the box with Titebond. Hold in place with masking tape. When dry, rough to shape with a large, sharp knife. Do final shaping with 60-grit sanding blocks, finish with 120-grit sandpaper.

Add the Mosquito-like cabin sep-

*(Continued on page 122)*

# NAME THE PLANE CONTEST

## Can you identify this aircraft?

If so, send your answer to: **Model Airplane News,** Name the Plane Contest (state issue in which plane appeared), 632 Danbury Rd., Wilton, CT 06897.

Our mystery plane featured in the August 1986 issue of *Model Airplane News* was the very beautiful Miller HM-4, a product of the genius of Howell Miller of GeeBee fame and president of Miller Aircraft in Springfield, Massachusetts.

The HM-4 was powered by twin 125-hp Menasco C-4 four-cylinder in-line inverted engines and had a maximum airspeed of 170 mph. The wingspan was 38 feet, the length was 26 feet, and the airplane was equipped with a retractable landing gear.

Congratulations to Gerard N. Benoit of Agawam, Massachusetts, for correctly identifying this aircraft. Other correct entries were received from Marshall Smith, George Younger, Chris Nugent, Kendall Thomas, and many others.

**The winner will be drawn four weeks following publication from correct answers received by postcard delivered by U.S. Mail. If already a subscriber, the winner will receive a free one-year extension of his subscription.**



## *SKEETER*

*(Continued from page 119)*

arately. This serves as a cooling air intake for the batteries. First assemble the 1/32-inch plywood air scoop, then cut the needed duct through the top foam fairing. Glue the plywood scoop in place and fit a suitable block of foam onto it. Glue the foam, then carve and sand to shape.

Align and attach the wing to the fuselage now. I left a little bit of fuselage fairing off aft of the fin, until the tail was installed and covered. Next align the tail to the fuselage and wing, and glue in place. Inspect the entire model and smooth-sand to prepare for covering. Fill any dings with spackling compound.

Cover the fuselage with 1½-ounce glass cloth and epoxy resin. I managed to cover the entire fuselage with one piece. It seems easier to apply the resin directly onto the wood, a small area at a time, and then rub the cloth into the wet area with your fingers. Start by brushing a

strip of resin down the top centerline. Then align and drape the cloth over the fuselage, and secure it with a strip of resin. Starting at about mid-fuselage and at the resin strip, wet a small adjacent area with resin and rub the cloth onto it. Keep working out and away from this point with small sections until one side is covered. Repeat this for the opposite side. The cloth will also wrap around the bottom. When the resin has set, sand the whole fuselage out with 80-grit sandpaper, then brush on a light coat of micro (a 5:1 mixture of resin and microballoons). Sand this out also, finishing with 120-grit sandpaper. Apply a coat of your favorite primer/filler and prepare for paint.

I covered both the wing and tail section with Coverite's* Micafilm for its lightness and strength. Micafilm has greater tensile strength than other films, which is important for stressed-skin structures. I covered the ailerons, rudder, and elevator before installing them on the already-covered surfaces. This makes covering easier and installation is simple using the Midwest Strip Hinges. I followed Coverite's instructions with one minor exception: I used a good heavy coat of Balsarite and sanded it out with 320-grit sandpaper before applying the film. This seemed to assure a nice, smooth film attachment.

For painting I sprayed the fuselage and nacelles with Coverite's Black Baron epoxy enamel; the Micafilm was already colored. The color scheme was a problem for me, but perhaps it won't be for you. The wartime Mosquitos all had that grey-green English camouflage, which is a dreary color. I wanted something bright! Happily, I recalled seeing a civilian Mosquito parked at a Canadian airport. This one was bright red with white English registration markings, just authentic enough so that I could have a red Skeeter with no misgivings!

FLYING. Do I need to mention a complete pre-flight check before flying, especially after all the effort you put into your Skeeter. Be sure to also check all surfaces for warps and set all control surfaces at dead neutral.

When an electric is taking off, one second it's sitting there peaceably, but with a flip of the switch it's in full power and moving out! Because of the sudden power surge, you need to be ready with rudder to correct any heading changes. Of course, if you opt for a speed control, the power can be slowly applied without that problem. An electric responds similarly to a full-scale, so don't expect to "horse it" around as you would with an over-powered engine type.

For normal flying you'll find the response of the Skeeter twin no different from your past favorite except for the appearance and the unique sound of those synched props. This is a solid flyer!

After the quick takeoff, maneuvering is where twin power shows its advantage. If you are an aerobatic pilot, you'll find that all maneuvers come easily from level flight, and consecutively when you want them to. I like the inverted flight, axial rolls, and cuban eights. The menu is your choice, enjoy your favorites with electric power this time!

With those two big 11-inch props freewheeling (drag personified!) I suggest you pay special attention to the landing procedure. It seems best, even though there are no tip stall tendencies, to keep the nose level and gliding speed up until close to touchdown, then a bit of up

*(Continued on page 125)*

# Classified

**RAZOR BLADES:** single-edge industrial quality, super sharp. 100/$4.25, 200/$8.50, 300/$12.50, 500/$20.50, 1,000/$40.50; add 10% postage west of the Mississippi. Cobbie's Gifts, Box 2, Deal, NJ 07723; 201-922-9898.

**1930-1950** model magazines for sale. Low price, $1.00 for list. Bruce Thompson, 328 St. Germain Ave., Toronto, Ontario, Canada M5M 1W3.

**WANTED:** RTF U-Control planes from Cox, Wen-Mac, Comet, Aurora, Testors, etc., complete or pieces, buy or trade. John Fietze, P.O. Box 593, Lynbrook, NY 11563.

**ANTIQUE MODEL IGNITION ENGINES—PARTS CATALOG,** 50 pages, precision cast timers, original cylinder heads, point sets, drive washers, tanks, for GHQ, O&R, O.K., many others. Large catalog $4.00 pp. Chris Rossbach, RD 1, Queensboro Manor, Gloversville, NY 12078.

**HARDWARE AND SOCKET HEAD** cap screws, all sizes, low prices. Write for complete list. Example 6-32x1" only $4.25 per hundred. Micro Fasteners, P.O. Box 42A, Netcong, NJ 07857.

**WANT TO BUY:** Spark plugs ¼x32 original production Champion V-2, V-3, or equivalent A-C, Autolite, etc. Any quantity. Woody Bartelt, 1301 W. Lafayette, Sturgis, MI 49091.

**FOR SALE:** 2,000 model airplane magazines. New condition. 1945 through 1985. Send $1 and SASE for list. J. Willard Vaughn, 506 Wadsworth St., Radford, VA 24141.

**R/C WORLD, ORLANDO, FLORIDA, CONDOMINIUM VACATION RENTAL:** Spacious two-bedroom, two bath beautifully furnished. Fly with other modelers on site on 100-acre flying field, paved runway, huge screened-in hangar, swimming pool. Minutes from Disneyland, Epcot Center, R/C car tracks, Kennedy Space Center, golf, and other attractions. Truly a family vacation spot. Rental available weekly, monthly, seasonal. For information, write to Debbi O'Connell, Air Age, Inc., Condo Dept., 632 Danbury Rd., Wilton, CT 06897, or call 1-800-243-6685.

**SIX NEW 1"= 1' CONSTRUCTION BLUEPRINTS** for "flying-scale" aircraft. Large S.A.S.E. for details. S.A. Lambert Jr., Apt. 308, 2200 W. Cornwallis Dr., Greensboro, NC 27408; 919-288-2944.

**PRIVATE COLLECTION:** Hundreds of aviation magazines for sale—*Popular Aviation, Flying, Model Airplane News, Air Trails, RAF Flying Review, Wings,* and many others. 1932-1960. All in excellent condition. Send $2 for list. William C. Fort Jr., 4161 Robin Hood Rd., Jacksonville, FL 32210.

**NEWEST TWO-CYCLE TECHNOLOGY:** Two new 61 Schnuerles that have all other 60 class engines for breakfast. The two new Fitzpatrick 61s—FSR-ABC. See full-page color ad in this very *M.A.N.* issue. Fitzpatrick Engines USA.

**APPLE AVIATION PUBLIC DOMAIN SOFTWARE AIRCRAFT DATA BASE AND SLIDE SHOW.** Two disks $24.95. Free catalog with purchase or send $1 for catalog to H.M. Technology, Dept. 1207, 1204 Ave. V, Brooklyn, NY 11229.

**WANTED:** Model airplane engines and model race cars made before 1950. Jim Clem, 1201 E. 10, P.O. Box 524, Sand Springs, OK 74063.

**DESIGNER WANTED:** R/C or slot racer with mechanical ability to work in research and development. Travel weekends. Reply: Parma International, Inc., 13927 Progress Parkway, N. Royalton, OH 44133 or phone: 216-237-8650.

**R/C SCALE PLANS:** Curtiss P6E, Curtiss Gulfhawk, others—$^1/_8$-scale $22.50, ¼-scale $35.50, catalog $1. Richard Barron, 11506 Ohio Ave., Youngtown, AZ 85363.

**SCALE DRAWINGS** of flying wings and other unique aircraft. Send $2 for catalog to: Bill Young, 8106 Teesdale Ave., N. Hollywood, CA 91605.

**BEGINNERS,** discouraged by too-fast "trainers"? Send $1 for treatise scale-rating over 20 well-known radio-control models for their ease-of-flying. Jim Waterman, 3818 Deerfield Dr., San Antonio, TX 78218.

**SELL YOUR HOBBY THINGS QUICKLY** and easily with Nationwide. For more info send self-addressed stamped envelope to Nationwide Model Exchange, 4444 Hazeltine #116, Sherman Oaks, CA 91423.

**HOBBY LISTINGS NATIONWIDE:** You might find the bargain you've been looking for. We have everything. Send $2 to Nationwide Model Exchange, 4444 Hazeltine #116, Sherman Oaks, CA 91423.

**FOR SALE:** Brazilian-produced T.M., Sassi, Mobral glo engines, .15, .40, .46, S.T.D. and R/C. Udo Eugen Linke, Caixa Postal 24, 18.130—Sao Rogue S.P. Brasil.

**CASH OR TRADE** of older ignition engines for Dooling .61 ignition and Austrian Dylla 5.9cc four-cycle. Bob Sellers, 15 Cherry St., Tiffin, OH 44883.

**FORSTER 35,** new in box. Coil and condenser, but less plug, $150.00. J. Locasto, 447 State St., San Mateo, CA 94401.

**SELL CHOICE PERSONAL ANTIQUE** gas model ignition engine collection $3,900 or best. 1½-hour video (VHS only) describing all engines. Video tape only $49.95 plus $2. Jule Dews, 7703 Baltimore National Pike, Frederick, MD 21701.

**OLYMPIC COLLECTORS:** Newsletter features news, ads, tips for beginning collectors and where to write for free pins. Three sample copies sent free. WJ Nelson, Box 41630, Tucson, AZ 85717-1630.

**MAKING SCALE MODEL AIRPLANES FLY:** Widely recommended book. All types: indoor/outdoor, monoplane/multi-plane, rubber/gas/$CO_2$/electric. Three scale plans included. Non-scale FF also, $8.95. Aircraft Data, Box 763576, Dallas, TX 75224.

**BOOKS FOR MODELERS:** Out-of-print/current. 400+ items list $1. John Roby, 3703B Nassau, San Diego, CA 92115.

**RAF ENTHUSIASTS:** We recommend *Lancaster to Berlin* as must reading. Pocket edition $5.50. Other titles available, send $1.00. Mail Media, Inc., P.O. Box 8392, Gainesville, FL 32605.

**POSTERS:** P-51 Mustang Pictorial Fastsheet—25"x35". Color $3.95. Complete list available. Mail Media, Inc., P.O. Box 8392, Gainesville, FL 32605.

**FOR SALE:** Private collection—engines, kits, plans. Send $1 for complete list and prices. Many of each. Mostly ¼-scale, $5,126 invested, will sell entire collection for $4,000. Moving within year. Must sell. Cameron Mertaugh, Rt. 1, Box 72A, Pickford, MI 49774.

Send ad and payment to: Classifieds, *Model Airplane News,* 632 Danbury Rd., Wilton, CT 06897.

**Non-commercial classified ads** (commercial ads of any kind not accepted at this special rate). Rate: 15 words or less, $4.50 payable in advance. No charge for name and address. Additional words, 25¢ each.

**Commercial classified ads** (rate applies to anyone selling on a commercial basis—retailers, manufacturers, etc.). Rate: 50¢ per word, payable in advance. Count all initials, numbers, name, address, city and state, zip and phone number.

**Closing date** for either type of ad is the 15th of the third preceding month (for example, January 15th for the April issue). We do not furnish box numbers. If you would like your ad to run in more than one issue, multiply amount of payment by number of months that ad is to run.

It is not our policy to send sample copies or tear sheets.

## ADVERTISERS INDEX
## OCTOBER 1986

# *SKEETER*

*(Cont nued from page 123)*

elevator will flare out a neat three-pointer.

On inception I had great hopes for the Skeeter. Considerable experience with it has given more enjoyable electric flight all the way! Others have reported fantastic twin-motor performance also. Perhaps you would like to join us with your own "Skeeter."

**The following are the addresses of the companies mentioned in this article:*

*Astro Flight, 13311 Beach Ave., Marina Del Rey, CA 90292.*

*S-R Batteries, Box 287R, Bellport, NY 11713.*

*Midwest Products, 400 S. Indiana St., Hobart, IN 46342.*

*Carl Goldberg Models, 4734 W. Chicago Ave., Chicago, IL 60651.*

*Hobbypoxy, Petitt Paint Co., P.O. Box 378, 36 Pine St., Rockaway, NJ 07866.*

*Coverite, 420 Babylon Rd., Horsham, PA 19044.* ■

# *HELICOPTER BASICS*

*(Continued from page 29)*

rubber and the servos should be firmly mounted. Make sure that the servo cases are not touching the mounting plates. If they do the servos might not work reliably or may fail prematurely. The gyroscope should be mounted with doublesided foam tape. Don't wrap the gyro sensor in foam rubber; it needs to follow the movements of the helicopter exactly and foam will dampen its sensation of these movements. Run the receiver antenna as far away from the metal of the machine as possible. Many people route it around the main chassis inside plastic tubing and fix it to the tail skid or stabilizer with a rubber band. An alternative is to install one of the short base loaded whip antennas on the market.

Rotor blades can be covered with pressure-sensitive contact sheet, heat-shrink tubing, or even fiberglass and paint. Each method has its advantages and disadvantages. Probably the easiest to use is heat-shrink tubing. It slips over the rotor blade like a sock and is shrunk to a tight fit by steam or the cautious use of a heat gun. Be careful if a standard heat gun is used because the covering can be easily melted. The disadvantage of

heat-shrink tubing is that it's not firmly attached to the rotor blade. At flying rotor speeds the shrink tube has a tendency to balloon off the airfoil, disturbing the airflow. Precoating the rotor blades with Coverite's Balsarite before shrinking the covering will help keep the covering stuck to the blades. This technique works well for the narrower blades such as those on the smaller .28 size and the GMP machines, but on machines with wider blades such as Schluter's I recommend using contact sheet covering.

Contact sheet covering is slightly harder to apply than shrink tube but it offers several advantages. Contact sheet sticks firmly to the blade airfoil, it adds strength to the blade, and it won't bend the thin balsa trailing edges of some rotor blades. Rotor blades can be painted or fiberglassed and painted. Only solid hardwood blades can be painted without the added strength of fiberglass. Hardwood and balsa composite blades need the extra strength covering gives to keep



# Club of the Month

The Rocket City R/C Club of Florida is the *Model Airplane News* "Club of the Month" for October 1986.

Living in and around Orlando, Florida, certainly has its advantages, especially if you're a modeler. One advantage is the opportunity to belong to one of the finest modeling groups in the country, the Rocket City R/C Club. Their membership is limited to 75 and they presently have that, plus 30 more who are on a waiting list.

The club has monthly meetings at the Camelot Mobile Home Park and each meeting is filled with business and entertainment. They regularly show video tapes and have discussions about building projects. Besides the regular flying sessions, outdoor activities consist of field trips to museums, picnics, float-plane flying, and visits to other clubs in the area. In addition, the club sponsors youth activities and participates in local community affairs. Bob's Hobby Center in Orlando is one of the hobby shops that members patronize, since it caters to most of the needs of these active R/Cers. Some of the other hobby shops include Central Florida Hobbies in the Pine Hills Shopping Center and also the Hobby Box Hobby Shop in Altamonte Springs.

*Model Airplane News* is pleased to award two free one-year subscriptions to this club for their outstanding efforts, which are to be given by them to their deserving junior members.

Congratulations!

**Each month M.A.N. will select the club newsletter that best shows the club's activities and energies directed toward the furtherance of the hobby. The award is not based on size or quality of the newsletter, and can be about any aspect of the hobby (F/F, C/L, R/C, boating, cars, etc.). M.A.N. will award two free one-year subscriptions to be given by the club to outstanding junior members. So send your newsletters to Model Airplane News, Club of the Month Contest, 632 Danbury Rd., Wilton, CT 06897.**

them together. Fiberglassing blades produces a nice result but it's very time-consuming to finish a set of blades in this manner.

No matter what method is used to cover the blades, when they're complete, add a ¾-inch or larger strip of contrasting color tape to one blade tip to facilitate blade tracking. However, don't add it until you're ready to balance the blades. The main and tail rotors must be well balanced and it's a long job if you want perfection. In order to get the blades in perfect balance, they must be balanced on three axes. This is easy in theory but difficult in practice. The procedure is a little too complicated for this forum but there are articles on the subject elsewhere. The method I use is simpler, less time-consuming and works almost as well.

Basic balancing of rotor blades is relatively easy. First find the lateral balance point of each blade by resting the blade chordwise on a straightedge. I use a ruler in a vise, then slide the blade along its length until it balances. Do the same with the other blade right next to the first. Since the wood in each of the blades isn't exactly the same density they usually will not balance at the same point. The goal is to get both blades to balance the same distance from the mounting holes. Use the tracking tape to get both blades to balance at the same point. Vary the amount of tape used to get the balance right. Now mark this balance point on each blade with a felt-tip pen. Remove the rotor head from the machine and mount the blades.

Place the head on a High Point balancer using the flybar as the axle. If a High Point balancer isn't available, a pair of parallel straightedges will work. Balance the head by adding tape to the light blade at the point previously marked so that it hangs level. Once the blades are balanced, seal all the edges with cyano-acrylate glue to prevent oil from getting under the tape. Don't use too much glue because it can change the balance. For slight corrections drops of glue can be used to get the blades in perfect balance.

The tail rotor should also be balanced. On most machines the tail rotor hub can be removed and balanced with the blades in place. The flybar must also be balanced by placing a wheel collar on each side of the flybar before mounting the control paddles. Use ⅛-inch collars for 3 mm bars and 5/32-inch collars for 4 mm bars. When installing the control paddles use a ruler to get them exactly the same distance from the center of the rotor head. The flybar is balanced by sliding the wheel collars in or out until the flybar hangs level.

Next month I'll go into the correct setup of R/C helicopters. See you then. ■

## *R/C NEWS*

*(Continued from page 38)*

big bird—the life you save may be my own! One way to learn about giants is to get *Giant Steps** by Don Godfrey. This book covers everything you need to know to be successful in giant scale.

Art Schroeder, c/o *Model Airplane News*, 632 Danbury Rd., Wilton, CT 06897.

**The following are the addresses of the companies mentioned in this article:*

*Selig Solomon, Treasurer, IMAA, 28 Buck Rd., E. Brunswick, NJ 08816.*

Giant Steps, *Air Age Publishing, 632 Danbury Rd., Wilton, CT 06897.* ■